(1)

CONFERENCE PROCEEDINGS

RAND

Defense Modeling and Simulation Office Information/Data Base Technology Working Group (I/DBTWG) Meetings Held During the Week of July 11–15, 1994

Edited by Iris M. Kameny

National Defense Research Institute

The research described in this report was sponsored by the Office of the Secretary of Defense under RAND's National Defense Research Institute, a federally funded research and development center supported by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies, Contract MDA903-90-C-0004.

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Published 1994 by RAND
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Prepared for the Office of the Secretary of Defense

National Defense Research Institute

Approved for public release; distribution unlimited

PREFACE

This document contains the proceedings from the Defense Modeling and Simulation Office (DMSO) Information/Data Base Technology Working Group (I/DBTWG) meeting and related Task Force meetings held at the Institute for Defense Analysis (IDA) during the week of July 11–15, 1994. (Note that the name of the I/DBTWG has been changed from the previous name I/DB Task Group (I/DBTG)).

The work described here was performed for the Defense Modeling and Simulation Office as part of its initiative to strengthen the use of simulation and modeling throughout DoD. RAND's participation in this effort was performed for the Director, Defense Modeling and Simulation Office within the Applied Science and Technology Program of RAND's National Defense Research Institute (NDRI), a federally funded research and development center sponsored by the Office of the Secretary of Defense and the Joint Staff.

This work should be of interest to those working in the areas of interoperability of information systems, information resource management (IRM), data dictionary systems, resource directories, data modeling and use of IDEF tools, complex data, data verification, validation, and certification (VV&C), data quality, and assessment of data management technology.

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SUMMARY

This document contains the proceedings from the Defense Modeling and Simulation Office (DMSO) Information/Data Base Technology Working Group (I/DBTWG) meeting and related Task Force meetings held at the Institute for Defense Analysis (IDA) during the week of July 11–15, 1994. (Note that the name of the I/DBTWG has been changed from the previous name I/DB Task Group (I/DBTG))

The DMSO I/DBTWG was formed in January 1992 from the Information Technology and Data Base Technology working groups who met from August 1991 through December 1991 to perform technology assessments in support of the DMSO Master Plan. The original TWGs were mainly composed of representatives from federally funded research and development centers (FFRDCs). Two documents describing earlier I/DBTWG activities are: (1) "Defense Modeling and Simulation Office Information/Data Base (I/DB) Task Group Meetings Held February 14–18, 1994, and Notes from the Previous Two I/DB Meetings," RAND CF-114-DMSO, 1994, and (2) "Database Technology Activities and Assessment for Defense Modeling and Simulation Office (DMSO) (August 1991—November 1992)," RAND MR-130-ACQ, 1994.

Because data is critical to Modeling and Simulation, the main and continuing purpose of the I/DBTWG is to provide the M&S community, at low cost and with efficiency, timely, verified and valid data to promote reuse and sharing of data, interoperability of models and simulations, and improved credibility of modeling and simulation results.

The DoD Corporate Information Management (CIM) initiative continues to address many of the data related needs of the M&S community but not all. It is important for the M&S community to be aware of the data needs not being met by CIM and unlikely to be met by commercial or other DoD means. These data needs should be brought to the attention of the Defense Data Administration Program Management Office (DAPMO) and if DoD attention to them is not timely or inappropriate, then they should be addressed by the M&S community. It is critical that the I/DBTWG continue to monitor DoD CIM activities and help DMSO develop compatible M&S guidelines and procedures whenever possible.

The I/DBTWG is currently co-chaired by Dr. Chien Huo from the DISA/JIEO Center for Standards who is working with the DMSO to carry out their data administration and standards program, and by Ms. Iris Kameny from RAND who led the first Data Base Technology Working Group and has been supporting DMSO since 1991 in their data related activities. Dr. Huo and Ms. Kameny are working with CDR Gary Misch (DMSO) and with LTC (P) Jerry Wiedewitsch, the Deputy Director of DMSO.

The I/DBTWG has grown from around a dozen members at its inception to over 100 members today. It consists of people from the Services, Joint Staff, DoD agencies, Intelligence Community, ARPA, NIST, NASA, OSD, FFRDCs, and contractors working on government M&S programs. The I/DBTWG currently meets twice a year with the next meeting scheduled for February 6–10, 1995 at the Institute for Defense Analysis in Alexandria, Virginia. The I/DBTWG has created three Task Forces which have Subgroups each of which has co-chairs who are predominantly from the Services and the Joint Staff. The I/DBTWG Task Forces and their Subgroups meet more frequently as needed.

Because of its size, the I/DBTWG has become more of an information exchange forum for the data suppliers to the M&S community than an action body. Members make requests for information mainly about data standards, repositories, directories, data quality, complex data, etc. and the meeting agenda is developed according to the expressed needs. In addition, I/DBTWG members and others are invited to brief about their M&S projects, database environments and

centers to support M&S, and non-M&S oriented databases and systems used by the M&S community. This exchange has been very helpful in getting different organizations to know each other and work together toward exchanging and reusing databases rather than developing redundant databases.

Accomplishments of the I/DB include:

- Developing the M&S Information System at DTIC and the I/DBTWG portion on an internet gopher server at RAND.
- Development of initial data models and standards for a Database Directory and a Model and Simulation Directory (each can be used as a "standard" core by different organizations enabling sharing of directory information across the M&S community).
- Carrying out an initial pilot study of modeling complex derived data using the Army TRAC weapon performance data (e.g., probability hit, kill) and sharing the lessons learned with the community.
- Development of a methodology to build subject area information data models through reverse engineering, and training organizations in carrying out these activities utilizing IDEF modeling techniques (the Joint Data Base Elements project).
- Supporting DMSO in becoming the delegated Functional Data Administrator (FDAd) for the M&S functional area.
- Currently developing a Data Administration Strategic Plan (DASP).
- Being instrumental in getting CIM to address complex data and derived data in their new Defense Integrated Repository System data model.
- Defined complex data as "data which is difficult or awkward to model using commonly existing techniques (i.e., IDEF1X and other kinds of Entity-Relationship modeling) and defined non-exhaustive categories of data meeting the definition of being "complex" as: inheritance, composition, derivations, mappings, and artifacts of legacy systems.
- Defined data verification, validation, and certification for data producers and users .

To expedite work in data related support for M&S, the I/DBTWG has three Task Forces in the areas of Data Verification, Validation, and Certification (VV&C), Data Standards, and Complex Data. Each of these groups met during the week of July 11–15, 1994.

Specific tasks being addressed by the Data VV&C Task Force include:

- Develop guidelines for data VV&C including definition of a data quality profile to describe the condition of a dataset or database (e.g., completeness, accuracy, resolution, audit trail, derivation, and the V&V tests applied to the data) and requiring that the profile be part of the certification process.
- Addressing Authoritative Data Sources: developing taxonomy of data areas, identifying authorities for those areas, developing a directory of the authorities, and a guideline to responsibilities of an Authoritative Data Source. Defining the roles of M&S data centers that receive data from authoritative sources and prepare it for input to models.

— Working with the Distributed Interactive Simulation (DIS) M&S Verification, Validation and Accreditation (VV&A) WG and the DMSO VV&A TWG to integrate the data VV&C process into DIS and non-DIS VV&A processes.

Specific tasks being addressed by the Data Standards Task Force include:

— Developing the requirements for an M&S Information Resources Repository system that can meet M&S repository needs for managing metadata, instance data, and models and simulations.

— Writing a "white paper" to present to the DIS Workshop on "DIS Needs for DoD Data Standards."

Specific tasks being addressed by the Complex Data Task Force include:

— Exploring the use of advanced modeling tools for modeling complex data in a more user friendly way.

— Performing pilot studies on complex data, in particular on weapons performance data for the Navy and Air Force to complement the previous pilot study of Army weapons performance data.

— Defining and developing a taxonomy or index (e.g., keywords, phrases) to support access to models, simulations, and databases for browsing and reuse.

Tasks to be performed by the future Data Security Requirements Task Force

— Address the M&S data security requirements including: the need to access and acquire data from different classification levels, data aggregation, multi-level metadata, etc.

ACKNOWLEDGMENTS

The I/DBTWG co-chairs would like to thank Ms. Linda Quicker of RAND for her efforts in coordinating the I/DBTWG meeting and Task Force meetings and in preparing this proceedings. We would also like to thank Mr. Jim Heusmann for his administrative support during the entire week of meetings.

1. INTRODUCTION

PURPOSE

The purpose of this document is to provide the proceedings of the July 11–15 Defense Modeling and Simulation Office (DMSO) Information/Data Base Technology Working Group (I/DBTWG) meeting to members, to provide information to people who wish to participate in the I/DBTWG, and those with an interest in data activities related to modeling and simulation.

BACKGROUND

In 1991 the Deputy Secretary of Defense instituted a major new initiative to strengthen the application of modeling and simulation (M&S) in the DoD. Its purpose is to promote the effective and efficient use of M&S in joint education, training and military operations, research and development, test and evaluation, analysis, and production and logistics by: (1) establishing OSD cognizance and facilitating coordination among DoD M&S activities; (2) promoting the use of interoperability standards and protocols where appropriate; and (3) stimulating joint use, high return on M&S investment. Achievement of these goals requires the development and implementation of a DoD M&S policy, establishment of a DoD-wide management structure to coordinate joint M&S activities and requirements, and the formulation and implementation of a long range M&S joint investment strategy.

A DoD Executive Council for Modeling and Simulation (EXCIMS) consisting of DoD Component representatives was established as a board to advise the USD(A&T) on M&S policy, initiatives, M&S standards, and investments for improving current M&S capability and promising M&S advanced technologies. The Defense Modeling and Simulation Office (DMSO) was established to serve as an executive secretariat for the EXCIMS and to provide a full-time focal point for information concerning DoD M&S activities. The DMSO promulgates USD(A&T)) directed M&S policy, initiatives, and guidance to promote cooperation among DoD Components to maximize M&S efficiency and effectiveness.

To carry out its functions and develop a master plan, the DMSO enlisted the help of several Federally Funded Research and Development Centers (FFRDCs). A number of functional and technology working groups were established to determine the M&S needs and to evaluate the state-of-the-art with respect to those needs. The Functional Working Groups are: Education, Training and Military Operations (ETMO); Research and Development; Test and Evaluation; Analysis; and Production and Logistics. The current Technology Working Groups are: Architecture; Information and Databases (I/DB); Verification, Validation and Accreditation; Networking; Environmental Representation; Computer Generated Forces; Human System Interfaces; and Interoperability with C3I Systems. The current I/DB grew out of two original TWGs: the Information TWG and the Data Base TWG.

During initial startup activities, the Information Technology Working Group (ITWG) began to develop plans and design of a DMSO Information System to facilitate coordination among DoD M&S activities. The Database Technology Working Group (DBTWG) identified three efforts found critical to M&S needs: need for directories, dictionaries, encyclopedias, and repositories to support timely and cost effective access to, acquisition of, and validation of external and derived databases; interoperability, data integrity and consistency across distributed databases and simulations; and M&S community objective assessment of data management products such as relational DBMSs. COL Jim Shiflett of DMSO, asked that the two TWGs be joined into the

I/DB Task Group which was done. Recently, upon DMSO resurrection of the TWGs, the name of the I/DB Task Group was changed to the I/DBTWG.

Two documents describing previous I/DBTWG activities are: (1) "Defense Modeling and Simulation Office Information/Data Base (I/DB) Task Group Meetings Held February 14–18, 1994, and Notes from the Previous Two I/DB Meetings," RAND CF-114-DMSO, 1994, and (2) "Database Technology Activities and Assessment for Defense Modeling and Simulation Office (DMSO) (August 1991—November 1992)," RAND MR-130-ACQ, 1994.

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The I/DBTWG has grown from around a dozen members at its inception to over 100 members today. It consists of people from the Services, Joint Staff, DoD agencies, Intelligence Community, ARPA, NIST, NASA, OSD, FFRDCs, and contractors working on government M&S programs. The I/DBTWG currently meets twice a year with the next meeting scheduled February 6–10, 1995 at the Institute for Defense Analysis in Alexandria, Virginia. The I/DBTWG has created three Task Forces which have Subgroups each of which has co-chairs who are predominantly from the Services and the Joint Staff. The I/DBTWG Task Forces and their Subgroups meet more frequently as needed.

Because of its size, the I/DBTWG Task Group has become more of an information exchange forum for the data suppliers to the M&S community than an action body. Members make requests for information mainly about data standards, repositories, directories, data quality, complex data, etc. and the meeting agenda is developed according to the expressed needs. In addition, I/DBTWG members and others are invited to brief about their M&S projects, database environments and centers to support M&S, and non-M&S oriented databases and systems used by the M&S community. This exchange has been very helpful in getting different organizations to know each other and work together toward exchanging and reusing databases rather than developing redundant databases.

OBJECTIVES OF THE I/DBTWG

Because data is critical to Modeling and Simulation, the main and continuing objective of the I/DBTWG is to provide the M&S community, at low cost and with efficiency, timely, verified and valid data to promote reuse and sharing of data, interoperability of models and simulations, and improved credibility of modeling and simulation results. To accomplish this goal requires data administration policies, procedures, standards, and supporting tools compatible with those of CIM and the Services. It also requires access to information throughout the M&S community about what is happening as well as information about the existence and availability of models and simulations and the data they need. Of critical concern to the community is the quality of the models and simulations as well as the data they use and generate.

Current Status in Meeting Objectives

Data administration objectives are being addressed through the delegation of M&S functional area data administration responsibilities to DMSO. DMSO is now the Functional Data Administrator (FDAd) for M&S and is developing its first Data Administration Strategic Plan (DASP).

Support for Data Standards. The Joint Data Element Interoperability (JDBE) project sponsored by DMSO has developed a methodology (documented in a Military Handbook) to build subject area information models through reverse engineering of existing databases using IDEF1X tools. This is being extended to support the development of data standards. The JDBE project is available to M&S data projects for IDEF training and help in developing their data models.

Directories. One of the original M&S community requests (from all of the functional working groups) was for directories to M&S databases and models and simulations. This is being addressed. Data models for both directories have been developed, have undergone community consensus and are being implemented. These directories, various M&S data centers and M&S program reuse libraries need a taxonomy or index (e.g., key words or phrases) to enable access to the stored objects and information in a user friendly way for browsing and reuse. The Complex Data Task Force has a Taxonomy Subgroup that has developed initial taxonomies for both directories.

M&S Information System. The M&S Information System was developed to meet the M&S community's needs for access to information and it has become operational over the past year. An I/DBTWG portion of the system is maintained on an internet gopher server at RAND.

The Complex Data Task Force. The I/DBTWG recognized the lack of attention in the CIM community to data standards for scientific and technical data and formed the Complex Data Task Force to address these needs. Much M&S data is not atomic single concept data addressed by the CIM data standardization process (in accord with DoD 8320.1-M-1) but is complexly derived (e.g., probability hit, kill), or structurally complex (e.g., a road network, an object-oriented engineering view of a weapon system), or multimedia data (e.g., images, graphics, voice), or conceptually complex (e.g., rules, operation orders) data. A Complex Data Task Force task has been to define complex data and to categorize it.

Complex data has been defined as "data that is difficult or awkward to model using commonly existing techniques (i.e., IDEF1X and other kinds of Entity-Relationship modeling). A non-exhaustive set of categories for complex data has also been defined to include: data represented in object inheritance relationships such as multiple inheritance, multiple roots, and poly-instantiated data; data represented in composition relationships such as "part-of", complexly derived data such as probability hit/kill (as opposed to simply derived data such as "age"); data requiring inter-model and intra-model mappings; and composed data that are artifacts of legacy systems (e.g., basic encyclopedia number).

This TF has also been working with the CIM Defense Information Repository System (DIRS) project to include complex and derived data in its data model. Current complex data tasks include finding and trying out new data modeling techniques that will be more user friendly and to perform additional pilot studies using these modeling techniques (preferably for Air Force and Navy weapons performance data). In addition, its Taxonomy Subgroup continues to address taxonomy issues.

Data Standards Task Force: This Task Force has two Subgroups: the Repository Subgroup and the DIS Standards Subgroup. The Repository Subgroup is developing the requirements for an M&S Information Resources Repository (IRR) system that can meet M&S repository needs for managing metadata, instance data, and models and simulations. It is to be based on a Technical Architecture Framework for Information Management/Technical Reference Model (TAFIM/TRM) architecture with minimal standards and conventions and a common tool base. The prototype IRR will support the M&S FDAd functions at DMSO. The long term vision is of a distributed confederation of IRRs that can seamlessly exchange information resources.

The DIS Data Standards Subgroup will be presenting a paper at the September DIS Workshop on "DIS Needs for DoD Data Standards" and will work with DIS to form a working group to address DIS data standards.

Data Verification, Validation & Certification Task Force. The VV&C TF has formed two Subgroups: the VV&C Guidelines and Quality Profile Subgroup and the Authoritative Data Sources Subgroup. The Guidelines Subgroup is developing guidelines for the VV&C of data and is working closely with the DMSO VV&A TWG and the DIS VV&A Working Group to integrate the data VV&C process into the DIS and non-DIS VV&A processes. It is developing guidelines for data VV&C including definition of a data quality profile to describe the condition of a dataset or database (e.g., completeness, accuracy, resolution, audit trail, derivation, and the V&V tests applied to the data) and requiring the profile be part of the certification process.

CIM has recently become interested in promoting data quality within the DoD. The main difference between their data quality program and the development of the M&S quality profile effort appears to be that they are engaged in establishing data quality standards within DoD while this Subgroup is trying to develop a way to describe the quality of a database independent of a quality standard. Some M&S databases (e.g., intelligence force assessments, futures) are by their nature incomplete, of variable probability of belief, etc. This is the type of information (as well as other kinds of data) that will be captured in the profile.

The Authoritative Data Sources Subgroup is concerned with the ability of M&S users to find and acquire the instance data they need for their M&S and for that data to be VV&Ced, configuration managed, etc. This Subgroup is developing a taxonomy of data areas, identifying authorities for those areas, developing a directory of the authorities, and a guideline to responsibilities of an Authoritative Data Source. They are also defining the roles of M&S data centers that receive data from authoritative sources and prepare it for input to models and are concerned with release authority issues.

Data Security Requirements. An additional need that will probably be addressed in the near future by creating another task force is to define the data security requirements for M&S data to include the need to access and acquire data from different classification levels, data aggregation, multi-level metadata, etc.

ORGANIZATION AND STRUCTURE OF THIS DOCUMENT

This document contains the proceedings from the Defense Modeling and Simulation Office (DMSO) Information/Data Base Technology Working Group (I/DBTWG) meeting and related Task Force meetings held at the Institute for Defense Analysis (IDA) during the week of July 11–15, 1994.

Section 1 contains the introduction.

Section 2 contains the highlights of the I/DBTWG meetings during the week of July 11–15, 1994.

Section 3 contains notes for the main I/DBTWG meeting held on July 11–12, 1994 which includes an update on DMSO happenings; reports from I/DBTWG task forces and subgroups; updates on data administration, standardization and modeling activities; reports about other organizations; reports from Service M&S organizations with respect to data related activities; reports from Functional Working Groups; and reports from M&S data related projects.

Section 4 contains notes on the repository discussion held on Monday, July 11 at 1700 at DMSO.

Section 5 contains the notes for the Complex Data Task Force meeting held on Wednesday, July 13, 1994.

Section 6 contains the notes for the Data Standards Task Force Meeting held on Thursday morning, July 14, 1994.

Section 7 contains the notes for the Data VV&C Guidelines Subgroup held on Thursday afternoon, July 14, 1994.

Section 8 contains the notes for the Data VV&C Task Force meeting held on Friday, July 15, 1994.

The Appendices contain the briefing charts for all the meetings and a list of acronyms.

2. I/DBTWG MEETING HIGHLIGHTS

The 8th I/DBTWG Conference was a success. Dr. Chien Huo of DMSO, Ms. Iris Kameny of RAND and Services' representatives co-chaired the I/DBTWG plenary session and its three task forces (TF) meetings: Complex Data, Data Validation, Verification and Certification (VV&C) and Data Standards. Over 60 people attended, representing the Services, Joint Staff, OSD, DMA, DIA, JIEO/CIM, CINCs, NIST, NASA, industry and academia. The conference's main theme was data standardization and management. In addition to the speakers from DoD, I/DBTWG also invited experts from the NIST, NASA, academia, and non-government standard bodies such as ISO, IEEE, X3H2, X3H4. There was a positive interchange of information throughout the conference agenda.

Results from the Task Force Meetings
The I/DBTWG received a list of priorities and issues from each of the task forces (TF) at the conclusion of the meetings. These issues will be regarded as a general guidance for the task forces and I/DBTWG to press on. The top priority issues are summarized below:

a. Data Standards Task Force:

- Develop procedures and guidance for the M&S data element developers submitting proposal packages to DoD for data standardization
- Develop M&S repository requirements to support M&S data administration program in accordance with the DDRS/DIRS
- Provide interoperability across M&S data repositories (i.e., CENTCOM's Conventional Force Database (CFDB), J8's Operational Analysis and Simulation Interface System (OASIS), Automated Repository for M&S System (ARMS), etc.)
- Provide electronic exchange of metadata and instance data (standard file formats, exchange mechanism)
- Perform pilot studies of reverse engineering on CFDB, data modeling on CFDB while assessing C2 Core Data Model, forward engineering on Universal Threat Simulation System (UTSS), and modeling complex data such as Pk, Ph with Navy's and/or Air Force's data

b. Data Verification, Validation and Certification Task Force

- Incorporate VV&C process into DIS VV&A process model and quick planner
- Develop IDEF0 process models for user data VV&C for Non-DIS applications (i.e., Army, Navy, Air Force, JS, OSD)
- Finalize taxonomy for authoritative data sources
- Identify the responsibilities for data centers, authoritative sources and users
- Define how classified data centers can exchange data with other centers and release data to users. Address data aggregation and release authority issues
- Develop VV&C Guideline to include database quality profile

c. Complex Data Task Force

— Perform pilot studies of complex data such as Pk, Ph with Navy's or Air Force's data

d. Form a new Task Force to address data security and MLS requirements

Suggested Briefings for Next I/DBTWG

(1) DoD megacenter client/server architecture: Bill Tuffy

(2) DDRS update

(3) Global Command and Control System (GCCS)

(4) DoD data security and quality: Jerry Cooper 703–636–6900

3. I/DBTWG MEETING NOTES

3.1 AGENDA

MONDAY, JULY 11, 1994
UPDATE ON DMSO HAPPENINGS

0800–0830	Welcome and DMSO Update: LTC (P) Jerry Wiedewitsch
0830-0900	M&S Data Administration Update: Dr. Chien Huo
	REPORTS FROM I/DB TASK FORCES AND SUBGROUPS
0900–0915	Report from M&S Data VV&C Task Force Subgroup on VV&C Guidance including Data Quality Profile: Mr. Bob Hartling
0915–0930	Report from M&S Data VV&C Task Force Subgroup on Authoritative Data Sources: Mr. Bill Dunn
0930–0945	Report from M&S Complex Data Task Force Subgroup on Categorization: Mr. Len Seligman
0945–1000	Report from M&S Data Standards Task Force and also on taxonomies: Ms. Iris Kameny
1000–1030	Break
1030–1100	Report on M&S Directory and Databases Directory Progress: Dr. Mike Frame
1100 – 1130	Report on MORS Simulation Data and Its Management (SIMDATAM) Senior Advisory Group (SAG): Mr. Howard Haeker
	DATA ADMINISTRATION, STANDARDIZATION AND MODELING ACTIVITIES
1130-1200	Update on ASD(C3I) Data Standardization Policies and Procedures: Mr. Bob Molter
1200-1300	Lunch
1300-1330	Status of Repository Standards: Mr. Bruce Rosen
1330-1400	Report from Intelligence FDAd: Mr. George Endicott
1400-1430	Report from Acquisition and Technology FDAd: Mr. Gary Hurd
1430-1500	Report from C2 FDAd: Mr. Stan Plummer
1500-1530	Break
1530-1600	JIEO/CIM Plan for M&S Support: Ms. Carla Von Bernewitz
1600-1630	Report on ISO Data Representation: Mrs. Melody Rood
1630-1700	Discussion of Initiatives on External Data Standards and Migration Planning: Mr. Phil Cykana

TUESDAY, JULY 12, 1994
REPORTS ABOUT OTHER ORGANIZATIONS

0800-0830	Report on NASA Conference on Catalog Interoperability/NASA Science Internet (CI/NSI): Ms. Patricia Liggett
0830-0900	Report on BMDO Data Management: Mr. Allen Hess
0900-0930	Overview of C2 Core Data Model: Dr. Robert Walker
0930-1000	Report on IEEE IDEF1X Working Group: Mr. Peter Valentine
1000-1030	Break
1030-1100	Report on Army Data Standards Organization Experience with IDEF1X and Data Standards: Mr. Jim Glymph

REPORTS FROM SERVICE M&S ORGANIZATIONS
WITH RESPECT TO DATA RELATED ACTIVITIES

1100-1120	Update from Army Modeling and Simulation Management Office (AMSMO): Mrs. Lana McGlynn
1120-1140	Update from Air Force XOMT: Lt Col Cheryl Balombini
1140-1200	Update from Navy M&S Office: Mr. Dean Free and LCDR George Flax
1200-1300	Lunch

REPORTS FROM FUNCTIONAL WGS

1300-1330	DoD M&S Master Plan Process: CDR Mike Lilienthal
1330-1400	Report from Analysis Functional Working Group: Mr. Jim Heusmann for Dr. Pat Sanders
1400-1430	Report from Production and Logistics Functional Working Group: Mr. Fred Myers

REPORTS FROM M&S DATA RELATED PROJECTS

1430-1500	Report on Environmental Effects in Distributed Interactive Simulation (E2DIS) Project: Dr. Harry Heckathorn
1500-1530	Break
1530-1600	Report on Master Environmental Library: Dr. John Harding
1600-1630	Report on Naval Battle Force Tactical Trainer (BFTT): Mr. James Hammond
1630-1700	Wrapup: Dr. Chien Huo and Ms. Iris Kameny

3.2 ATTENDEE LIST

I/DBTWG GENERAL MEETINGS
MONDAY, 11 JULY 1994

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TUESDAY, 12 JULY 1994
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3.3 UPDATE ON DMSO HAPPENINGS

LTC (P) Jerry Wiedewitsch, Deputy Director of DMSO: Welcome and DMSO Update
LTC (P) Wiedewitsch told the I/DBTWG that the new DMSO direction is technically oriented toward near-term payoff. It is highly concerned with interoperability issues. Examples of synthetic environment use include American manufacturing, operations other than war such as disaster relief, weekend training, major forces exercises, and training and wargames. The Defense Simulation Internet (DSI) is viewed as a subset of the global grid/national communications highway. The information highway will be able to be accessed through the DSI. There will be funds for pilot projects especially in the integration of live, virtual and constructive simulations, and integration of M&S into C4I systems.

One initiative that will be demonstrated in the first week of November is Atlantic Resolve (what used to be REFORGER) and the Synthetic Theater of War - Europe (STOW-E). This will be an exercise in confederated constructive simulations and will be joint and combined with participation from NATO, USAREUR, USAFE, and NAVEUR. It will involve the Warrior Preparation Center (WPC), a Joint Task Force, Allied Headquarters, and Exercise Control Center in Germany. The WPC will be running an ALSP supported exercise at the Joint Staff level. The Army will have instrumented forces at Hohenfels linked with virtual simulators at another location in Germany. The scenario uses France as an island nation with live forces operating in Germany with virtual and constructive forces in France. The Navy will have two carrier battlegroups, one in the South and the other in the North. The technology will be supporting the training objectives and after the exercise, STRICOM plans to keep the technology, software and communications infrastructure in place.

From a STOW-E 94 Joint Task Force with 10,000 entities and 15 locations, ARPA is looking to a USACOM sponsored STOW 97 Joint Theater with 100,000 entities and about 50 locations, to a STOW 2000+ which will be an operational system with more than 100,000 entities and more than 50 participating locations worldwide. Multi-level security (MLS) will be a major issue since systems and forces will be operating at various security levels including unclassified, secret, secret NO FORN, and NATO. ARPA is looking at how advanced/new technology can transition into the operational world.

The major problem driving use of simulation for readiness is the complexity of the current and future warfighting and peacekeeping world. Complexity demands more practice, prototyping and experimentation than the DoD budget can support. M&S can bridge the gap by providing synthetic environments to expand training horizons, to develop a new acquisition paradigm and to explore new technologies. There is a Senior Readiness Oversight Council in which DDR&E is a member and a Readiness Working Group in which DMSO participates. The Defense Science Board (DSB) Readiness Task Force also supported the use of M&S for joint training.

There is a new Joint Service common architecture project called JSIMS. The MOA is being staffed and three Services have signed up and are forming a JPO. The initial product will be the architecture for the next generation of constructive wargames. Currently, JSIMS is funded mainly by the Air Force and additional DMSO funding.

The revised Science and Technology (S&T) strategy, currently in draft, identifies 20 technical areas, one of which is Modeling and Simulation. Each area is developing a Technology Area Plan (TAP) that will guide long term S&T investments. M&S is mentioned in most of the 19 other areas and the M&S plan will show interaction with over 50% of the other technology areas. The DoD is pursuing simulation as a strategic technology: simulate before you build, simulate before you buy, and simulate before you fight. These will help the warfighter fight smarter.

DMSO is currently working on the Defense Modeling and Simulation Master Plan. It will focus on readiness, be coordinated with the TAP, build a common vision across the entire M&S range of DoD, includes technical assessments (one will include the data issues area of M&S), and action plans to build interoperability and jointness and to fill voids. It will be the basis for investment strategy and will be updated annually. DMSO is changing its investment strategy from a wide sprinkling of funds to focusing resources on a few critical areas. For example, they may be delegating $20 million to be spent between 2-3 projects. They will be working with the Services to focus funding on interoperability problems.

LTC (P) Wiedewitsch's closing remarks were that the new DMSO Director CAPT Jim Hollenbach does have an understanding and background in data and should be "able to talk our language."

Dr. Chien Huo: Modeling and Simulation Data Administration
Dr. Huo acts as the Functional Data Administrator (FDAd) for M&S and is responsible for defining and carrying out the M&S data administration program. He is the co-chair of the I/DB TWG.

He presented the four DMSO objectives: (1) providing a technical framework for M&S; (2) developing authoritative representations; (3) integrating live, virtual and constructive simulations; and (4) broadening M&S applications.

The overarching purpose of the DMSO data related activities is to support the DMSO objectives by promoting interoperability, sharing and reuse of data and models. This purpose is being carried out in coordination and compliance with DISA/JIEO/CIM; through data standardization and related efforts not being addressed by CIM or the commercial world; and with participation and concurrence from the M&S community.

The M&S FDAd responsibilities include: implementing an M&S DA infrastructure to establish community consensus on policies, procedures and standards; identifying and promulgating DA methodology and tools; addressing important technical issues (e.g., complex data standards, data VV&C, authoritative data sources); establishing an M&S repository requirement, directories for databases and M&S; and facilitating the interchange of information and lessons learned. Many of these activities are being carried out through the I/DB Technology Working Groups and their Subgroups: Complex Data (Subgroups: categorization and guidelines, taxonomy, pilot studies), Data VV&C (Subgroups: data VV&C guidelines and quality profile, authoritative data sources, and pilot studies); and Data Standards (Subgroups: repositories and DIS data standards).

3.4 REPORTS FROM I/DB TASK FORCES AND SUBGROUPS

Mr. Bob Hartling: Report from M&S Data VV&C Task Force Subgroup on VV&C Guidelines Including Data Quality Profile
The Data VV&C Task Force is chaired by Iris Kameny. The Guidelines Subgroup is co-chaired by Bob Hartling (Navy) and Mark Ralston (Army). The Authoritative Data Sources and Data Centers Subgroup is co-chaired by Bill Dunn (Army) and Mike Hopkins (CENTCOM).

The long range objectives for the Task Force (April 19, 1994) are to (1) develop guidelines for Data VV&C including definitions and process, cost models and information, and quality profile metadata definitions; and (2) address authoritative data sources and their responsibilities and the role of M&S data centers between data sources and simulation centers.

Progress: (1) VV&C definitions have been agreed to; (2) work is ongoing in defining the VV&C process in relation to the M&S VV&A process for DIS and non-DIS; (3) the Subgroup is working with an Army and DMSO funded VV&A task force and with the DIS VV&A Group.

The DIS VV&A group falls under the DIS Fidelity, Management and Usability Working Group. The DIS VV&A group has accepted the top level VV&C process (developed by this Subgroup) integrated into the VV&A process diagram that was the outcome of the last DIS Workshop. The Subgroup has incorporated the VV&C procedures in a quickplanner that references the DIS VV&A quickplanner. When this is acceptable, a pilot study will be run using the process defined in the quickplanner. The plan is to have initial data VV&C guidelines ready to present at the September 1994 DIS Workshop.

The DMSO/Army funded VV&A task force dealing with non-DIS distributed simulations is also collaborating with this Subgroup since the VV&C process may be different for non-DIS usage. Peggy Gravitz is heading up that project's data consistency task. When the VV&C process is defined and integrated into their VV&A process, they will run tests.

VV&C Definitions (April 19, 1994) from Data VV&C TF Meeting at IDA

Producer Data

Producer Data Verification: The use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling.

Producer Data Validation: The documented assessment of data by subject area experts and its comparison to known or best-estimate values within stated criteria and assumptions.

Producer Data Certification: Determination by the data producer that data have been verified and validated.

User Data

User Data Verification: The use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and that data are transformed and formatted properly.

User Data Validation: The documented assessment of data by subject area experts and its comparison to known or best-estimate values as appropriate for use in an intended M&S.

User Data Certification: Determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage.

Mr. Bill Dunn: Report from M&S Data VV&C Task Force Subgroup on Authoritative Data Sources

Authoritative Data Sources Subgroup taskings: provide agency names and relationships for authoritative data sources; provide agency names and responsibilities of data centers; address sharing and reuse of data between/among these data sources and centers; and address responsibilities of data customers.

Accomplishments: They have found that no Service has comprehensively assigned authoritative data sources. They have prepared a draft document (19 April 1994) that discusses sources that are authorized and defacto, lists sources identified by Services and CENTCOM, discusses responsibilities of data center and data customer, and notes that multiple source entries are required due to data aggregation, and security.

Current/future work: They are working on a data source taxonomy that will be Service extensible; need to populate taxonomy; need guidelines for security and data release authority; need to evolve document to address policy and management issues; and need to address maintenance of the Authoritative Data Source directory by DMSO/IAC.

Mr. Len Seligman: Report from M&S Complex Data Task Force Subgroup on Categorization
The Complex Data Categorization Subgroup goals are: develop categorization of "complex data"; and to provide feedback to relevant groups on modeling of complex data (i.e., M&S Repository Subgroup, Defense Integrating Repository System (DIRS)).

Accomplishments are: They have developed an initial categorization (April 1994) and have given feedback to Jeff Wolfe, DISA/JIEO/CIM/DAPMO, on the preliminary version of the DIRS model with respect to derived data.

Definition of complex data: Data which is difficult or awkward to model using commonly existing techniques (i.e., IDEF1X and other kinds of Entity-Relationship modeling).

Non-exhaustive categories of data meeting the definition of being "complex": inheritance, composition, derivations, mappings, artifacts of legacy systems.

Next steps: need to assess appropriateness of different modeling techniques for complex data (such as object-oriented modeling techniques or IDEFxx); and continue discussions on DIRS and other relevant repository efforts.

Ms. Iris Kameny: Report on M&S Data Standards Task Force and also on Taxonomies
The Data Standards TF has two Subgroups: Repositories co-chaired by Jim Augins (support of NAVY/ARMS) and Pete Valentine (Army/JDBE), and DIS Data Standards chaired by Walt Swindell (Army/TRAC).

Suggestions for possible scope and focus of group (Feb. 15, 1994) were: coordination of data modeling and data standards development (standards committees, consortia, etc.), M&S repositories, M&S standard-based data libraries (data sources), data classification (i.e., data security issues).

The output of the April 20, 1994 meeting included five issues in addition to the formation of the Repository Subgroup: (1) paper to DIS on need for data standards (being addressed by Swindell, Haddad and Kameny); (2) data model for DIS enumeration document (JDBE doing); (3) M&S policies and data standards (Chien Huo/DASP); (4) starter set of data elements for M&S (Chien Huo); (5) develop M&S corporate view of sharable databases and standards based on Components' requirements (province of Authoritative Data Sources Subgroup).

A paper on "DIS Need for DoD Data Standards" was collaboratively written by Iris Kameny, Luci Haddad, Peter Valentine, Jim Watson and Walt Swindell and has been accepted for presentation at the September 1994 DIS Workshop. It addresses: the evolution of data standards, the DIS Vision and its void with respect to use of data standards, specific ways in which the use of data standards can benefit the DIS program and exercises, data standardization, a future vision of DIS with data standards, and DIS roadmap to data standardization.

The Repository Subgroup has identified a need to define requirements for a distributed M&S Information Resources Repository System. It will enable rapid access, acquisition and processing of quality, consistent, valid data and other information resources for use by the M&S community. Its architecture will be based on a minimal set of standards, conventions and common tools, to be implemented and tailored for use by M&S organizations, data centers, M&S programs, etc. and collectively accessed as a distributed repository system. A M&S IRR may contain objects such as process and data models, data standards, nomenclature and symbology standards, directories (for M&S and databases), algorithms, databases, M&S, and common and specialized tools.

Taxonomies: There is a recognized immediate need for taxonomies for the database directory, the M&S directory, and the authoritative data source categories. There is a Taxonomy Subgroup under the Complex Data TF co-chaired by Iris Kameny and Dan Hogg—but no meetings have been held. RAND has developed initial taxonomies for the database and M&S directories and sent them around the I/DB community for review. Walt Swindell (TRAC) took the RAND taxonomy for databases and integrated it with the TRAC data subject area taxonomy and that is being used by the Authoritative Data Sources Subgroup. The other taxonomies have been given to Mike Frame to incorporate into the database and M&S directory data models. (As of July 14, the Taxonomy Subgroup has been stopped and its activities subsumed by the Repository Subgroup.)

Dr. Mike Frame: Report on M&S Directory and Database Directory Progress
IDA has completed the logical database design and initial physical database design and implementation. They are currently working on refining the physical DB implementation; evaluating and processing Army Mosaic data for initial population of the M&S directory; designing paper data capture "forms"; evaluating electronic data forms; and evaluating World Wide Web (WWW) Mosaic as a browsing and query tool. The systems should be in production early in 1995.

They need to: complete the design of the paper data form; complete evaluation of file format alternatives (including those for updating through a tagged exchange file standard); complete evaluation of WWW Mosaic; acquire list of standard queries and reports; develop set of browsing plans; be responsive to ARMS Project need for database information; address population of database directory; and need policy and procedures for entry of data into the directories, and to specify who does the data editing and reviewing, etc. DMSO would like each Service to be responsible for its own information.

Mr. Howard Haeker: Report on MORS Simulation Data and Its Management (SIMDATAM) Senior Advisory Group (SAG)
The SIMDATAM SAG was formed by the MORS Executive Council whose chair is Mike Bauman. Their mission is to guide future MORS activities in this subject area. Their purpose is to provide guidance, answer questions to the MORS sponsors and be a sounding board on how the future SIMDATAM meetings should be conducted.

The first SIMDATAM meeting was held on June 8 in Colorado Springs during the 62nd MORS Symposium. An outcome of the meeting was to make tentative plans for the next SIMDAT Symposium to be held in March 1995 at the Army War College. Plenary topics include: DDRS/DIRS, IDEF, security rules/regulations. Chuck Getty is the point of contact for the plenary sessions at 717–732–9210. Suggested working sessions are: VV&C; standards; enabling technologies (e.g. research issues, storage, COTS, object-oriented, BLOBs, use of legacy systems); reconciliation of data standards with major programs; and security. Security is a very important issue and needs policies and procedures. A suggestion was made to work with the DIS Security Council; Chris Bowens was suggested as a POC at 717–732–9210.

3.5 DATA ADMINISTRATION, STANDARDIZATION AND MODELING ACTIVITIES

Mr. Bob Molter: Update on ASD(C3I) Data Standardization Policies and Procedures
Molter went over the DoD Data Administration program implementation status with regards to policy, standards, infrastructure, procedures, tools, DA training, and miscellaneous. Policy is incorporated in 8320.1 approved September 26, 1991.

Standards: Database language is FIPS 127–2 with current work on 3. The IRDS FIPS 156 may be replaced in the future by combining IRDS2 and PCTE. He expects the Federal Government to require the use of IDEF1X (FIPS 184) for data modeling and IDEF0 (FIPS 183) for process modeling by a year from now. Currently, DoD 8020.1 says to use IDEF0 for process modeling.

Infrastructure: The people are in place and megacenters are being planned. We asked some questions about the megacenters as they appear to have much in common with needs of M&S data centers and he suggested we get a brief at the next meeting from Bill Tuffy—particularly on their concept/use of client/server architecture. An enterprise integration implementation strategy was signed last month. They are planning to use EDI (electronic data interchange) and to get data out of documents through use of an SGML to tag parts of the document.

Procedures: Data Administration (DoD 8320.1-M) was approved March 1994; Data Element Standardization (DoD 8320.1-M-1) was approved January 1993, and data modeling, data security, data quality assurance and database administration are in draft. Jerry Cooper is the POC for security and data quality (703–636–6900). DoD 8320.1-M-x on data modeling will be coming out soon for review. They are trying to accelerate data element standardization by looking at subfunctional areas with all relevant parties joining in on collaborative sessions. For the spatial data, they are having collaborative sessions but addressing well defined subsets such as harbors, transportation focus on systems, etc.

Tools: Enterprise model published January 1994 includes the DoD strategic data and process models. He drew a pyramid with the Enterprise Model at top and part way down the activity and data models for strategy split apart, then there was a horizontal split and below the Enterprise Activity Model was the DoD activity model and below the Enterprise Data Model was the DoD Data Model. He said the strategic level view of both the activity and the data model are called the Enterprise Model and below is the DoD Activity Model and the DoD Data Model. Upon questioning, he said that the C2 Core Model is an external view of the DoD Data Model: e.g., 100 entities from the C2 Activity Model. He said to talk to Phil Cykana about integration of the C2 core model with the DoD Data Model. There is a need to map these so that when the C2 Core Model changes it is reflected in the DoD Data Model and vice versa. Commercial products are needed to help with the DoD Data Model both in viewing it and in growing it. The DAPMO is looking for some way to distribute the DoD Data Model.

The central repository (DDRS) is operational and populated with standard, developmental and migration data. He is concerned with why the M&S community is developing an M&S repository architecture. DA is in the process of selecting candidates for a migration system. They have data repository agreement on the DDRS; there is an interim repository. The DDRS solution includes acceptance of a PC companion. ICASE was awarded in 1994.

Miscellaneous included: 2 DASPs have been published, the FY94 Planning Guidance was published, and a data migration prototype using reverse engineering is ongoing, data migration and implementation planning has begun and they are selecting a migration system.

Mr. Bruce Rosen: Status of Repository Standards
The scorecard for ANSI X3H4:

X3.138–1988, IRDS standard for user interface command language for screen/panel interface

X3.195–1991, IRDS export/import file format specification for bulk transfer

X3.185–1992, IRDS services interface (so other software can use IRDS database): supports entity/attribute relationship model with attributes on the relationship

The scorecard for ISO:

ISO/IEC JTC1 (Joint Technical Committee), SC21 WG3 IRDS Rapporteur Group

ISO IS 10728(E), IRDS services interface: interface not same as ANSI X3.185–1992. It is based on different models and beliefs. The ISO standard is based on SQL where ANSI'S services interface is based on database administration concepts. The ISO entity/attribute/relationship allows no attributes on relationships since it is SQL based.

ISO IS 10027(E), IRDS framework (US IRDS fits in this framework)

European Computer Manufacturers Association (ECMA): has no standing as a standards organization but what they try to put out are "standards" (mainly composed of Asians and Americans).

ECMA Technical Committee 33 (TC33)

ECMA 149, Portable Common Tool Environment (PCTE)

They have published a book on PCTE "PCTE Standard for Repository." PCTE is meant to be an interchange standard for CASE tools.

Rookies:

ECMA TC33 Technical Group for Object Oriented (TGOO).

North American PCTE initiative that is now part of the Object Management Group (OMG) and called Special Interest Group (SIG) PCTE.

OMG is a consortia and puts the OMG stamp of approval on what they like and try to get to product as soon as possible.

JTC1/IEC SC21 WG3 and ANSI X3H4 next step would be development of IRDS 1.5 standard, current IS 10728 with some OO added. Projected completion of this was July 1995. Next step after that would be IRDS 2.0, with new full "OO" capabilities, projected completion of this was July 1997.

ECMA TC33, ECMA 149, PCTE: a fast track JTC1 ballot of PCTE led to a new standard for repository. ECMA requested that the standard be placed under SC22. The IRDS 1.5 and 2.0 have been canceled in favor of ECMA TC33 ECMA 149, PCTE.

X3H4 has asked the OMC to remove them as TAG to ISO IRDS Rapporteur Group and be reassigned as TAG to the new ISO group responsible for PCTE and that X3H4 be renamed to whatever name is chosen for the new JTC1 group responsible for PCTE standardization.

Rosen believes that PCTE will become the focus of the repository to serve both software and data administration standards development and X3H4 will end up TAG to PCTE. The repository would be useful as a tool integrator as well as a data administration tool. PCTE uses an SDS description set, whereby each tool has its own SDS view into PCTE. CDIF fits in as a way to provide SDS information. Some issues: PCTE would be the underlying mechanism for tying together tools from various vendors by providing database functionality. However, PCTE doesn't assign unique IDs to objects only link addresses. There is no concept of object identity. Right now IRDS doesn't map into PCTE at all.

This could mean that US IRDS (X3.138) would remain viable as user interface standard and US IRDS Export/Import could remain viable but US IRDS Services interface and ISO IRDS (IS 10728) would be dropped.

Rosen says that it is likely that the ISO IRDS group will die. Over the last year or so they mostly consisted of representatives from the US, UK, Japan, Australia, and a few others. The UK standards committee has stopped funding UK participation.

As regards IRDS FIPS 156, government regulations say that any organization buying a dictionary has to buy a product compliant with FIPS 156. Currently, there are two vendors sort of compliant with IRDS: INFORMIX and INFOSPAN.

Mr. George Endicott: Report for Intelligence FDAd
This scheduled presentation was not made.

Mr. Gary Hurd: Report from Acquisition and Technology FDAd
Dr. Leland Jordan is the acting A&T FDAd. Mr. Gary Hurd effectively operates the CIM and DA programs for Dr. Leland Jordan. One of A&T's functional areas is Science and Technology under which M&S falls.

The A&T CIM Integration (ACI) program was instigated by C3I and executed by the ACI office. Its mission was to facilitate the integration of all A&T CIMS with one another and with non A&T CIM efforts. The A&T community is large. The functional CIM offices in OUSD(A&T) are logistics, procurement, environmental security, economic security, systems acquisition management, science and technology, test and evaluation, and atomic energy. The first three have been around longer and are further along in their programs than the last five. The purpose of the ACI Program is to define an approach for improving and integrating acquisition policies, business processes, and supporting information systems; assist DoD officials in acquisition reform; and achieve near-term changes in how DoD operates. Program responsibility resides with functionals and is executed through the functional stewards. The ACI facilitates the program start ups and integration activities.

The FY93–94 CIM initiative included implementation plans for the first three areas of logistics, procurement, and environment and the other five areas (added in October 1994 by the Perry memo) have been engaged in defining charters, organizational structure and holding workshops. For FY94, there is an integrated DASP for the A&T community. A decomposition of the Enterprise process and data models were used as a framework for integrating procurement models into the Enterprise Model. An information infrastructure was composed of a TAFIM based infrastructure and shared data topology. The shared information infrastructure is necessary in order to migrate bottom-up data standards into the top-down enterprise standards. However, their bottom-up models didn't integrate so well with the Enterprise Model. He invited Chien Huo to talk to him more about what they did.

Expected benefits are: improvement and control of A&T processes; identification of targets for performance improvements; basis for improved information systems; near-term reductions in information systems costs; and near-term improvements in decision support systems information.

Mr. Stan Plummer: Report from C2 FDAd
Ms. Deborah Castleman, OSD Deputy Assistance Secretary of Defense for C3, is the C2 FDAd. The C2 FDAd mission is to achieve a fully interoperable C2 environment through effective data standards coordination and program development, including data elements and data models for C2 projects, programs, and migration systems. The goals are to: support Joint and Combined operations, aggressively implement C2 DA, and to promote coordination, cooperation, and participation of Functional Areas and Components. There is a C2 DASP for the years 1994–2001. The main functions of the C2 FDAd program are to: provide standard data elements, maintain the C2 core data model, integrate C2 subarea data models, and coordinate with FDAds and CDAds. The program also is supporting the Global Command and Control System (GCCS), which is its principal C2 migration system, by accelerating data standardization through focused sessions and collaborative modeling. This is a Quickfix migration system intended to replace WWMCCS and will include a Joint Service agreed to Common Operating Environment (COE). COL Connelly is in charge of GCCS integration.

In the data modeling area they are developing subarea models that will be integrated with the C2 Core Model and as a result may propose changes to the DoD Data Model. Ongoing efforts include: C2 Core Data Model, Fire Support Model, Air Operations Model (in candidate status), and SOCOM Model (Logicon will be working on integration of this with C2 Core Model later this summer). The C2 data elements have been gathered from the C2 Core Data Model, C2 input to starter set (exists but not as a result of data modeling), and JUDI data elements (on hold for now).

C2 Core Data Model status (8 July 1994):

	Prime Words	Data Elements
Developmental	103	349
Candidate	31	189
DoD Standards	53	30

The C2 FDAd has recognized the configuration management of data models to be a problem.

Ms. Carla Von Bernewitz: JIEO/CIM Plan for M&S Support
Ms. Von Bernewitz is the Director of the Data Administration Program Management Office (DAPMO). The DAPMO mission is to define, plan and organize the DoD Data Administration Program to promote definition, organization, operation, supervision, and protection of data within the DoD as a strategic resource. Originally DoD had an 8 year schedule for standardizing data but Perry's Oct. 13, 1993 memo mandated a 3 year requirement for standard data and so an interim solution was needed. The interim solution is to develop interim standards including industry standards and map existing databases to those standards by using a different approach than strictly top-down. The long term solution is integrated databases that use the data standards. Data as part of the system life cycle was shown in three steps: (1) the plan for data standardization is developed and described in the DASP; (2) data standardization is carried out based on DoD 8320 and results in metadata; and (3) the data standards are used by taking subject databases and mission applications and re-engineering AIS applications based on standards through use of standard-based data (DAPMO), applications (PSA/FAPM), and technical infrastructure (DISO). The AIS developments use the DDRS and I-CASE tools.

The standardization review process consists of informal review (developmental) followed by formal review (candidate) based on formal review packages that receive cross-functional review,

followed by approved status (standards stored in DDRS) or disapproved or issues are forwarded for resolution to the DASD(IM). Collaborative modeling involves joint modeling and review of a subject area with fdads, FDAds, CDAds and DAPMO all participating to get to standard data elements more quickly. This is a change from looking at legacy systems for possible data elements to standardize. Instead the process is to select subject areas to data model and from those data models define the data standards. Data standards are not being hard coded rather they are expected to change. Washington defines the tables of prime words and class words and then lets the collaborative efforts and benchmarks use those as parts of the data element names rather than the earlier strictly top-down naming approach. They need CASE tools to aid in the collaborative modeling.

The DDRS was recently put on an HP box so there are no more problems with access. It will use an Army tool for downloading and will also be distributed re CD-ROM disk. Data models will be available by the end of July. They need a repository solution to tie all the standardization objects together. The DDRS bulletin board has 60 internal customers, 17 FDAds and 29 CDAds. Chien Huo should be on the DDRS steering committee since M&S is interested in a repository.

The data standardization status (July 8, 1994):

	Prime Words	Data Elements
Candidate	76	304
Approved	280	632

Comment was that they haven't seen use of the data standards by application developers yet. And a question was left open about moving to object-oriented, and if so, then when.

Mrs. Melody Rood: Report on ISO Data Representation
Her purpose was to familiarize us with the emerging international ISO standard for data elements, ISO/IEC 11179 "Specification and Standardization of Data Elements."

The purpose of the standard is to enhance sharing of data (meaning/content) across systems by standardizing data element design. A common understanding of data will be achieved by standardizing the attributes of data elements (metadata) to fully specify a data element's meaning, identification and representation, and by standardizing terminology.

ISO and ANSI standards committees in this area: ISO/IEC JTC1/SC14 Data Element Principles (International Organization for Standardization/International Electrotechnical Commission, Joint Technical Committee 1, Subcommittee 14); and ANSI X3L8 Data Element Representation.

Important things to know about ISO/IEC 11179: it doesn't standardize individual data elements; is methodology and application independent; developed with international/multilingual users in mind; and has many testers including Bellcore and EPA in US.

Outline of ISO/IEC 11179, Data Element Specification and Standardization, Parts 1–6:

Part 1, Framework for the Specification and Standardization of Data Elements

Part 2, Classification of Concepts for the Identification of Domains

Part 3, Basic Attributes of Data Elements: five kinds are identifying, definitional, relational, representational, and administrative (these total to less than 50 metadata elements)

Part 4, Rules and Guidance for the Formulation of Data Definitions

Part 5, Naming and Identification Principles for Data Elements: a unique nonintelligent identifier must be assigned to each data element

Part 6, Registration of Data Elements
(More information on each of these Parts can be found in the briefing charts.)

Inputs/comments to the standard are welcome via ANSI X3L8 or via Mike Gorman to mgorman@mitre.org.

What is a data element? It is a single unit of data that in a certain context is considered indivisible. It is a field in relational database tables, attribute of entity type in Entity-Relationship Diagram (ERD), attribute in logical data model, and attribute of object class in object model.

Phil Cykana: Discussion of Initiatives on External Data Standards and DoD Data Administration
8320.1 series guidance includes national, international and federal standards. There is a need to accelerate development/establishment of DoD data standards. He showed us the approach used in taking FIPS standards (FIPS PUB 5–2 codes for identification of states, DC and outlying areas of US and associated areas, and FIPS PUB 6–4 which covers counties and equivalent entities in US) and integrating these into an IDEF1X model.

He showed us an example of the Defense Logistics Agency interfacing ANSI X.12 terms and definitions into DoD data standards. The IDEF1X metamodel for this shows the relationships of ANSI X.12 transaction set, data segment and data element to an external-data-element entity that is related to a DoD-standard-data-element entity.

The expected results of this are: use of 1500+ X.12 data standards by DoD, FDAd and CDAd participation; and acceleration and use of DoD data standards.

3.6 REPORTS ABOUT OTHER ORGANIZATIONS

Ms. Patricia Liggett: Report on NASA Conference on Catalog Interoperability/NASA Science Internet (CI/NSI)
NASA Distributed Active Archive Centers (DAACs) are single points of contact for a user to get data from other sites (DAACs). NASA would like all of the DAACs' data to be based on the same data model. They are moving toward the HDF standard but don't want to restrict the NASA EOS DIS world to a single standard. Right now they have no firm requirements, "centers" vary from very large DAACs to a single scientist working in the boondocks collecting data. They need to have a system that makes it easy for the user to access and acquire data and for centers to supply data.

As far as data quality: scientific data may change as the type of processing applied to it changes and there may even be a need to go back to source data and re-derive it using new methods—a very costly thing to do. They have issued a paper on data quality and security. It is easier to exert quality and security measures on the large DAACs than on the smaller collector. Some NASA data that is available within hours to days for use in disasters is weather and global change data.

She believes the DAACs need to talk to DoD about the DoD concept of megacenters. The DAACs will be used worldwide. The Europeans and Japanese are cooperative partners in development and use of international space centers.

I/DB members can get on the NASA mailing list for RFPs resulting from Cooperative Agreement Notices (e.g., between ARPA and NASA). The subject of the last one was on applying NASA data to other uses.

They have been very concerned with catalog interoperability (CI) and ways to index and present data. They now use SQL-based databases but they are looking at object-oriented DBMS.

The Committee on Earth Observation Satellites (CEOS) has an International Directory Network (IDN). They are predicting saturation of the network due to scientific users and need better compression techniques and network management techniques. Their directories are DIF based which takes time and resources to implement. Many archives already make their information available through Gopher and WWW, etc. and some form of cross-archive (DIF and non-DIF based) text searches in pre-selected areas of interest would be a useful service (with warnings to the user).

The EOSDIS Core System (ECS) Data Handling System (EDHS) is the on-line distribution and storage system for documents about ECS. It is maintained by Hughes Applied Information Systems at the ECS development facility and a list of relevant white papers and technical papers can be found in the briefing section of this proceedings.

Mr. Allen Hess: BMDO Tests/Experiments Data Management Lessons Learned
Allen Hess described what BMDO did to provide a foundation for data management. This included establishing test data centers, consolidating all test/experiment data, creating a Data Centers Standards Committee (DSCS) and a Phenomenology Science and Analysis Group User Products Information Group (PSAG/UPIG); drafting a data management directive and vision, and providing core funding to support data management activities. All of the above would be useful within the M&S community.

The data centers are the focus of data management and not only serve as primary archives but also facilitate analysis by providing timely access to well documented and validated data and data products. They also satisfy federal regulations requiring preservation of data collected from federally funded projects.

The briefing (found in the briefing section of this proceedings) goes into detail on data center lessons learned and should be reviewed by the I/DBTWGs and Subgroups. In particular the Repository Subgroup should look at their industry/federal standards and distributed DBMS/client-server capabilities. The FDAd could see how they ensure the use of data standards across data centers. The Authoritative Data Sources Subgroup may be interested in the establishment of policy for the management of all the data (e.g., responsibilities), how release authority is handled, and how to prevent duplication of data among data centers. A Security TF would pay attention to security issues and user support and classification of aggregate data. The Taxonomy Subgroup may be interested in their robust keywork list for use with summary catalogs and database searches (at least as a possible subtree for BMDO type of data). The Data VV&C TF may be interested in interacting with them on what they are doing in the VV&A/C areas.

Hess provided us with a good graphic of the management of experimental and modeled phenomenological data (see brief). He points out that there are lots of DoD and federal regulations related to data centers that need to be observed. He said that BMDO developed a data cost model but it is not being used due to cutbacks (we might want to look into this more). To access BMDO data, one just needs to get to one data center since the master catalog can be accessed from any of them.

Dr. Robert Walker: Overview of C2 Core Data Model
The purpose of data models is to provide a high-level specification of the information inputs and outputs of functional processes and information items subject to change, and to provide a consistent basis for data element standardization. Data models do not limit the choice of representations for storing data physically in a system, presenting data to users, presenting data to communications systems, or exchanging data internally within an automated system. They do not limit the choice of language for users, programmers or database query. He showed Zachman's Framework for information systems architecture and related data modeling to data, activity modeling to function, and DISA architecture to the network.

The DoD Enterprise Model provides a defense enterprise-level view of the DoD Data Model. The DoD Data Model is a single integrated data model for DoD and consists of approved entities and attributes under 8320.1-M-1. The C2 Core Model is a C2 view of the DoD Data Model. The JIEO/DAPMO integrates C2 and other functional area data models into the DoD Data Model.

The C2 Core Model was mandated by the MCEB to be finished by 8/93 and revised in 7–8/94. It differs from the C2 Generic Core Model accepted by NATO in that it excludes object-item and object-type to simplify integration with the DoD Data Model. It has been recommended for use by the C2 FDAd, Intel FDAd and Army ODISC4. It serves as a core for C2 model development and integration.

Concepts underlying the C2 Core Data Model: that the C2 focus should be on data for the elements of the battlefield and their employment, and that there is a common core underlying the C2 functional area. Battlefield elements comprise: person, unit, material, feature and facility. Activities employ objects both as resources and as objectives and the objects occur both generically by type and specifically by item. Objects can be located in a single way. Activities can be grouped and structured as actions to specify subactions, plans, orders and requests, and events. The C2 Core Data Model can provide a basis for integrating subfunctional areas, e.g., the Fire Support Data Model is the first extension of the common core.

Challenges are to coordinate the C3I modeling efforts by bringing together M&S with C2 and intelligence initiatives; integrating communications-electronics and environmental data modeling; expanding C2 as new requirements emerge; integrating C2 into one C2 data model; supporting development of the GCCS data model; and accelerating model integration and data standardization. Miscellaneous observations include: GCCS bolted together JOPES and Service's data with no integrated data structures; 8320 is missing standards for bit encoding; and the C2 Core Data Model development is missing guidance, funding, real estimates and agreement.

Mr. Peter Valentine: Report on IEEE 1320.2 IDEF1X Working Group
IEEE 1320.2 was formed from the group that wrote the current FIPS 184 and is the WG attempting to define the next generation of IDEF1X language. It is a mix of industry and government representatives.

List of Requests for Changes (RFCs) that the WG is working on:

- Make the FIPS 184 formalization description more understandable
- Add Rule Constraint Language (RCL) and required support
- Allow Discriminator from ancestor (allow use of any attribute in view as Discriminator)
- Support Multiple Inheritance

- Re-examine Alias support
- Specify the Transform Model
- Agree on Interchange format: IDL PAR withdrawn, Case Data Interchange Format (CDIF) under discussion
- Dictionary Hierarchy: hierarchies implicit in domains
- Usage Guidelines for Upper Zachman Framework rows: higher level modeling guidance
- Full method support: includes support for ADTs, methods with arguments and specification language

Other efforts include: conformance guidelines being worked on by NIST (Bruce Rosen); and WG members currently evaluating RCL by creating examples in each of their areas of expertise.

Issues: lack of vendor participation, and funding for development language components. Peter noted that the IDEF0 WG has better representation from vendors than does IDEF1X. Peter believes KBSI owns the rest of the IDEF methods: IDEF3 for active processes and IDEF4 for OO.

The IEEE 1320.2 is expanding IDEF1X from data modeling into object modeling. They are planning to introduce layered standards. They have been working with NIST on the IDEF1X conformance guidelines. Next Working Meeting was held at NIST on August 7–9. The POC is Mary Laamanen 301–975–3260.

Mr. Jim Glymph: The IDEF1X Experience
The Army data standardization organization is moving to DISA/JIEO/CIM on 1 October 1994. Carla Von Bernewitz, Director of the DAPMO, will be their new boss. They will be part of DoD but will be working for the Army on the Army backlog until it is finished. The Army Data Dictionary now uses the DoD 8320.1-M-1 structure, uses DoD class words, and uses "person" rather than "individual". He said that AR 25–9 will be going away and that when they move to DISA, the Army data standardization process will be to submit candidate proposal packages to Army ODISC4 where they will be submitted to the appropriate FDAd.

They have been working in the IDEF1X modeling arena since Oct 1990 and have developed 20 Army functional area models, the Army data model, 6 Sustaining Base Information Services (SBIS) application models and integrated view, and reworked the battlefield logistics model. The Army Data Model consists of models from TRADOC, Reserve component, SBIS, finance and accounting services, C2 Core Data Model, and battlefield logistics. A success story is that on modeling a recent training application they got 20% reuse of standard data elements and 40% reuse of entities. He expects these reuse numbers to go up as more areas are standardized.

Glymph showed four different ways to get to IDEF1X. The preferred way is through IDEF0 process modeling (they did 20 functional models that way). The process model is developed to the point where one can identify the information exchange requirements. Another approach, used for the six SBIS and training models, is to use the functional description for the "to be". A third way is a facilitated workshop bottom-up approach that starts with a database list of data elements and the user says which he needs. The last way is to reverse engineer a database model into IDEF1X, which they have done for programs that reached MAISRC without data standards.

Their lessons learned: it is critical to use a facilitator; need to use the right functionals (customer vs user); functionals need minimum IDEF training (e.g., 12 hours not a week or two); develop standards as you do the data modeling; and reuse data standards.

3.7 REPORTS FROM SERVICE M&S ORGANIZATIONS WITH RESPECT TO DATA RELATED ACTIVITIES

Mrs. Lana McGlynn: Army M&S Master Plan
Purpose of the Army M&S Master Plan is to promote the adoption of standards and common tools and processes in building and populating models and simulations for use in all applications throughout the Army. It is required by DoDD 5000.59 and was published 4 May 1994.

The Master Plan table of contents is shown below and discussed in more detail in the briefing charts:

Chapter I:	Introduction
Chapter II:	M&S Environment
Chapter III:	Standards Development
Chapter IV:	Investment Strategy
Chapter V:	Plan Implementation
Appendix A:	Glossary
Appendix B:	References
Appendix C:	Roles and Missions
Appendix D:	AMIP/DMSO Format

The Army will continue to have a standalone data standards system, even with Jim Glymph's group moving to DISA, but will stay aligned with the functional areas and will be merging more and more with them. They will be supporting an online VV&A catalog but it will not be open, it will only be available through Army specific points of contact.

In Chapter III, the Standards Development Process has well defined tasks: establish team arrangements; perform domain analysis; define standards/ services required; develop technical/procedural standards; achieve community consensus; build repositories; and educate and assist modelers/users. Categories for Standards have been defined: VV&A methodologies, data standards, system services, environmental representations, battlefield algorithms, operations other than war, strategic activities, cost representation, distributed simulation standards, computer generated forces, and user interfaces. Each category is assigned a coordinator and an initial assessment is made for each category for the six tasks in the standards development process. A crosswalk has been done between DMSO TWGs and the corresponding Army standards categories.

LtCol Cheryl Balombini and Maj Roger Van Epps: Update from Air Force XOMT
The DoD DA program is driven by OSD Functionals, supported by Components and technically administered by DISA. It covers data element standardization, data quality, data security, and data base administration. In the Air Force organizational structure: LtGen O'Berry is the CDAd, COL Larry Sipos (ret) is the Air Staff POC who coordinates with FDAds, the CDAd, and AFC4A/XPSD whose POC is Mr. Jim Neighbors who coordinates with the DAPMO, AF functional data coordinators, MAJCOM DAds and others.

AF/XOM provides guidance to the AF M&S community, oversees development activities, and fosters implementation of data standards for M&S activities. XOM functions are to provide AF MS&A leadership and policy; warfighter support for doctrine, strategy, training, wargaming and exercises; analysis support for requirements, force planning, COEA, acquisition, and T&E; technical support for standards, VV&A and technology assessment; and perform analysis to support USAF.

XOM is currently working on a master plan so there is no timeline for the following implementation steps: develop comprehensive M&S index/directory; assess development initiatives; employ standardized data in model development; and continue to evolve legacy systems. Currently, data collection is underway for the M&S index but data administration is in its infancy and they will work clos ly with the DoD community and pursue development of data standards where none exist.

They have the charter to oversee the joint framework for the next generation M&S environment for constructive simulations with the initial focus of replacing the ALSP confederation of models. The initiative is to eliminate: duplication, interface difficulties, data sharing problems and over investment of critical M&S dollars.

Beliefs about the future: simulation can lead directly to improved readiness for Aerospace forces; simulation provides the potential for significant improvement to the acquisition process; and simulation's promise will be lost without warfighter involvement and direction.

Mr. Dean Free and LCDR George Flax: Update from Navy M&S Office
Published in the "National Defense Authorization Act for FY94" on July 27, 1993 by the SASC: The committee notes the continuing lack of a central focus in the Navy on M&S. The Navy has been in the forefront of M&S at the technical level, though most of the activities are undertaken in the field and there has been little coordination and poor oversight over these activities. A coordinated focus in the DON could substantially improve the Navy's long range resources and operational planning.

Current view is that there is: an uncoordinated use of models; disparate and duplicative model development and database development and maintenance; few M&S have any level of V&V; there is expensive, ineffectual participation in distributed simulation exercises and demonstrations; poor transition of M&S R&D efforts to Navy programs; and uncoordinated efforts to build tools for the future.

The proposed management structure (shown in briefing) is for an M&S Advisory Council (with USMC EA and USN EA) and members from Acquisition, Doctrine, Training, Operations, Marines?, Assessment, T&E, and Logistics. There would be M&S fdads in each of the above mentioned areas to provide vision for use of M&S tools within the functional area, etc. There would be M&S policy, coordination and technical support for: VV&A instruction and coordination; support for common simulation framework; support for advanced simulation technology; and writing and maintaining master plan, investment and strategy, coordination with DMSO and Joint. The M&S Technical Support Office (SPAWAR 31 integrator) would interface with industry, program managers, ARPA/ONR/DMSO, N096, CNA and other FFRDCs, university labs, and Naval and other Service warfare centers.

Summary: Navy has an M&S mission; organization has been approved by the Undersecretary and includes data base development and maintenance; technically, among other things, NSS establishes a common framework, standards and protocols and is a prototype for JSIMS; distributed experiments are a key part of applications; there will be an automated repository for M&S; and VV&A will be supported.

LCDR George Flax is the Navy representative to the I/DBTWG and is involved with the ARMS program. The Navy ARMS system will have over 350 sources of instance data and they are trying to get the instance data out to users in spite of having no standards. They are providing the user with multiply sourced data and trying to develop tools for deconfliction (a semi-automated process using mediators). ARMS is a centralized repository drawing data from many sources and putting it into a common format. An objective is to consolidate redundant data gathering and distributed efforts. ARMS will ensure reliable sources of authoritative data use in assessment, be an electronic clearing house for data, and provide blue force data from the NWTDB. ARMS is secret high and there is an issue on how widely they can disseminate sensitive data (such as acoustic signatures). There is an issue with authoritative data sources in questioning the need to identify some sources. ARMS is implemented on the MAC and currently has characteristics, performance and effectiveness data and a partial set of red data. It is integrated with the ITEM Navy system, with MARS and an integrated analysis Navy system.

3.8 REPORTS FROM FUNCTIONAL WORKING GROUPS

CDR Mike Lilienthal: DoD M&S Master Plan Process
CDR Lilienthal began by showing a chart of the relationships from the USD(A&T) at the top to the Technology Working Groups (at the bottom) to which I/DBTWG belongs. (The I/DB Task Group is now known as the Information and Databases Technology Working Group (I/DBTWG).)

The DMSO four major objectives and subareas needing objective action plans are:

(1) Provide Technical Framework for M&S: develop simulation architecture, protocols and standards, and data base and repositories; and provide common tools (VV&A) and enhanced communications.

(2) Develop Authoritative Representations: for environment, terrain, behavior, and systems.

(3) Integrate Live-Virtual-Constructive Simulations

(4) Broaden M&S Applications: logistics, mission planning/mission rehearsal, acquisition

The overall process will be to: identify user needs through the Functional Working Groups, conduct technical assessments (every year) through the Technology Working Groups, establish Integrated Process Teams (IPTs), develop investment strategy and follow-through.

The tasks of the TWGs are to perform technology assessment, project guidance, project mentoring (making sure DMSO projects are moving along on the right path), community coordination (I/DB meetings and TWGs are an example), and participation in Integrated Process Teams. The existing TWGs are Architecture, Information and DataBase, Verification, Validation and Certification, and Networking. The new TWGs will be: Environmental Representation, Computer Generated Forces, Human System Interfaces, and Interoperability with C3I Systems.

The tasks of the FWGs are to validate needs, prioritize the sub-objectives, identify major Component programs and participate in Integrated Process Teams. The FWGs are: Education, Training and Military Operations, Analysis, Research and Development, Production and Logistics, and Test and Evaluation.

The outline for the Master Plan has sections on introduction, vision, goal and objectives, organizations supporting Defense M&S, implementation strategy and Appendices for each of the four objectives and subareas.

DDR&E has identified 20 science and technology (S&T) areas, one of which is M&S. Each S&T area is preparing a Technical Area Plan (TAP). The team preparing the M&S TAP is chaired by Dr. Anita Jones and members are from the EXCIMS and MSWG.

The FY95 DMSO investment plan is to support efforts in three areas: (1) infrastructure (where the I/DBTWG falls), (2) FY94 IPL tails, and (3) focused areas that build on interoperability and jointness including support for mission rehearsal/mission planning, terrain, CGF/SAFOR (under consideration are logistics, acquisition, and test and evaluation).

The key organizations supporting DMSO include: M&S ATD, DISA, ARPA, ARPA/DISA AITS JPO, industry and academia, Congress, Intelligence Community, Services, Combatant Commands and Joint Staff.

The Senior Readiness Oversight Council (SROC) meets monthly. One of the DMSO goals is to improve readiness through simulations by applying existing simulation technologies to improve readiness training and monitoring with emphasis on Joint readiness, mission planning and rehearsal, Reserve Component readiness.

Dr. Pat Sanders (presented by Mr. Jim Heusmann): Report from the Analysis Functional Working Group
Analysis supports the decisionmaker in the: Requirements Process (JROC, operational commanders, CINCs, etc.) in mission area analysis, wargame analysis, battle lab output, etc.; the PPBS Process (DRB, Programmers) in resource allocation studies, value added analysis, etc.; and the Acquisition Process (DAB, PEO/PMs) in COEA, affordability assessments, trade studies, etc.

Effective analysis is relevant, responsive, and credible. It needs M&S that address the questions of interest to the decisionmaker and include factors to which the decision is sensitive; accurate and accessible data for terrain, atmosphere, behavior, weapons performance, cost, etc.; rapid scenario generation; analyst friendly M&S tools; PC-based M&S; confidence in analytic tools (i.e., standards and VV&A procedures and technology); and confidence in the analyst.

Mr. Fred Myers: Report from the Production and Logistics Functional Working Group
The P&L FWG was established in December 1991 by ASD(P&L). Its charter includes: foster a realistic portrayal of production (including industrial base capabilities) and logistics in war games and simulation; promote use of real world models to bring battlefield operations and maintenance requirements to the product design process; and to create a methodology for evaluating P&L M&S needs.

They surveyed M&S catalogs against their needs and looked at over 200 M&S.

They identified six key production needs:

(1) Production/manufacturing tools for integrated product and process development
(2) Technical processes and data models: production control and shop floor control models
(3) M&S support of remanufacturing and repair
(4) Coordination with national and international standards efforts (need common datasets and standards)
(5) Policy and management direction on standardization of M&S
(6) Industrial base reconstitution

They identified nine key logistics needs:

(1) Higher fidelity representation of logistics in combat models
(2) Credible logistics databases and data collection capabilities
(3) Planning/execution tool to support the CINCs in OPLAN assessments

(4) Analysis tools to study effects of force sizing and unit realignment on logistics infrastructure
(5) Acquisition logistics modeling
(6) Capability to quantify implications of alternative materiel management policy
(7) Analysis capability to evaluate NDI/COTS equipment performance prior to purchase
(8) Interfaces between live, virtual, and constructive models
(9) Tools to support logistics considerations in the PPBS process

Data management needs are for: common datasets to enable sharing; and data structure metadata (to make it easier to determine data usability, independently validate available data, develop inter-related models, and support consistency of results between models).

They cannot effectively use M&S capabilities without common data sets and recognized data structures—they are the key to successful M&S implementation. We need to be sure the key players are involved in the data activities and plan for evolving systems and standards since changes are inevitable.

3.9 REPORTS FROM M&S DATA RELATED PROJECTS

Dr. Henry Heckathorn: Report on Environmental Effects in Distributed Interactive Simulation (E2DIS) Project: An Object-Oriented Technology for Integrating Environmental Effects and Distributed Simulations
Dr. Heckathorn is the E2DIS PM and Chairman of the E2DIS Technical Management Council. The E2DIS mission is: to the extent that they impact weapon system performance and attrition, provide the means to incorporate sufficient and realistic environmental representations, effects and processes consistently in DIS. The goals are to provide E&E2 infrastructure for sensor response (recon, surveil, acquire, track, assess, etc.), platform motion (performance, trafficability, velocity, acceleration, etc.), and use of environmental models in decision aids and human factors. An important specific goal is to achieve the high fidelity simulation of sensor detection of targets.

Modeling issues for DIS include: adequate modeling of E&E2 is critical to realistic simulation of battlefield; attrition is what counts (if E&E2 doesn't effect the outcome of a simulated battle, its inclusion in DIS is hard to justify); sufficient-fidelity, physics-based models and data are required to handle the variety and dynamics of the real world; a broad range of scales and levels of fidelity are needed; DIS must handle dynamic environments in interactive, real-time mode for virtual simulation; and consistent representation and treatment of E&E2 is critical for a "fair fight."

Fundamental E2DIS jobs: methods to ensure common E&E2 across DIS cells; finding optimal solutions by testing against an objective function; exploring various methods to achieve goal of high correlation; judging solutions by how well they measure up to the objective function but temper with pragmatic requirements; and adopt workable development process.

The E&E2 includes: atmospheric sciences such as meteorology and its effects such as rain, snow, etc.; wind flutter effects on sensors; they don't do emissions but do obscurants such as smoke; and terrain. E&E2 changes include the effect of the fog rolling in on the way a sensor works. They may need to work in four dimensions: X, Y, Z, and time.

The eight tasks are: management and integration; survey requirements and capabilities; standards (define standard database structures, transfer formats and messages to allow E&E2 to be used in DIS); environmental representations (develop automated methodologies and procedures to put numerical environmental data into standard form); environmental effects and processes (provide sufficient fidelity, etc.); prototyping and experimentation (prove viability); and constructive simulations.

The E&E2 DIS 4D data must consist of basic measurable parameters; must maintain temporal continuity; consists of land, sea, air and space data that is physically consistent across boundaries of these domains; must be scalable, must be VV&Ced; and must be object-oriented. Currently, E2DIS requires two distinct databases: atmosphere and terrain.

The basic principle of OO database design is the layered interface that allows the user to specify input and output to a database without concern for implementation and allows different users to have different views of the same data. They plan to use COTS OODBMS technology. Contact Judith Herbst (STX in Washington) with respect to how OODBMS allows user to specify his data requirement and hide design, whereas RDBMS does not.

On data standardization: they are coordinating with existing DoD efforts and will submit standards to the CIM process. They require environmental PDU tables and there are a set of standard transfer formats they are developing or considering adopting (see briefing charts).

Question about use of BMDO Analytic Tool Box: it provides a confidence assessment without true VV&A.

Dr. John Harding: Report on Master Environmental Library
This is a DMSO FY94 new start that addresses the M&S infrastructure. The rationale for this project is that no standard, high resolution databases exist for realistic ocean, atmosphere and near space environment data. The Services, NASA and NOAA share access to large sets of environmental observations and models but no standard extraction methodology nor DoD library applicable to M&S exist. Long term vision is of an environmental library having features of: general M&S applicability, multi-service, digital, consistent from R&D through operations; and containing historical, statistical, and 4-D data.

Short term MEL approach is to build a rapid prototype; long term MEL approach is to recommend architecture and contents. The specific tasks are: environmental requirements; architecture; climatological and fixed databases; integrated synthetic scenarios; prototype demonstration; prototype evaluation; and management and integration.

The architecture task is looking at browsing techniques such as WWW Mosaic and the NEONS browser of which they gave a very good viewgraph demonstration. The Integrated Synthetic Scenarios task is identifying relevant 4-D scenarios, selecting and acquiring data and models to create prototype scenarios, creating integrated environmental scenarios, and populating the MEL prototype with them.

They eventually plan to work with E2DIS. MELS will bring data from NASA, NOAA, and DoD together which may require deconflicting the data.

Mr. James Hammond: Report on Naval Battle Force Tactical Trainer (BFTT)
BFTT concept is that the ship presents the most effective training site for appropriate operational and functional training. This allows ships to train using their own equipment, system configurations, and operational/casualty procedures. Enhanced training efficiency will result as training redundancy is identified/eliminated, a necessary reality in terms of future down-sizing of the Navy.

BFTT focus: incremental development by baselines; leverage off of existing training systems; utilize Navy standard databases; coordinate and integrate with other programs; build only what is necessary; use existing contracts when possible; and accelerate to support ATO/TTS and downsizing. BFTT will support operator/unit/team training, Afloat Training Organization (ATO)/Tactical Training Strategy (TTS); Battle Group/Battle Fleet commander training; and Joint training.

The BFTT gameboard is 4000 X 4000 miles, altitude 300K FT, ocean depth 16K FT, worldwide, and 2600 DIS entities (2K guided missiles, 500 countermeasures, and 100 environments). Developmental test IIA October 94: multi-ship/shore connectivity, battleforce and unit-level training, multi-warfare (AAW, ASW, and EW), DIS 2.0.3, technical measures are entities = > than 100, latency < 300 MS, synchrony > 98% and debrief 15 min (ship level) and 90 min (force level). The 95 development test is stepped up to show JMCIS interface and technically to handle entities = > 512, latency < 300MS, synchrony > 99.9% and same debrief. They plan on participating in future I/ITSECs and STOW-Ex's, DT-IIIA (FY96), and DT-IIIB (FY97).

The BFTT distributed backbone is DIS, and it uses models and databases to implement DIS. It is a customer of validated models and standard databases and is establishing a Database WG. BFTT database issues include: need to interface with most shipboard embedded trainers which don't work with NWTDB data; need to interface with many shore sites; must fill legacy databases under control of others (mostly NWTDB); must be interoperable across DoD; must have flexible database architecture to allow for future growth and at same time support legacy databases; DIS architectures achieve fidelity by employing real data; minimize traffic by pre-positioning correlated databases; following DoD data modeling approach; choosing optimum database schema (balance between OO (future) and legacy (RDBMS DoD installed base); and legacy intelligence databases are classified.

SPAWAR/NAVAR is addressing next generation computer resources. DISWG is tasked to define a Navy Standard Database by 1997: working with standards groups and industry to define potential COTS products; ARL-UT Research heads DB architecture WG; recommend NAVSEA use forum to develop candidate database development across combat system products.

4. REPOSITORY DISCUSSION ON MONDAY JULY 11, 1994 AT 1700 AT DMSO

This meeting was held to discuss and agree on the MITRE task objectives and coordinate that effort with the Data Standards TF Repository Subgroup effort co-chaired by Jim Augins and Pete Valentine.

Jim Augins said that the repository design should be driven by the life cycle maintenance of the data. Attention needs to be paid to mechanisms for use and maintenance of the repository as well as the telecommunications aspects of federated systems (for distributed repositories).

Agreement to MITRE's task deliverables:
MITRE's approach is to define the repository for DoD M&S military applications in the five DMSO functional areas in support of the warfighter

DESCRIPTION	PRODUCTS
1. Mission Statement Activities and product requirements	IDEF1X data model of repository
2. Standards affecting #1 Subset of #1 Identification/issues/impact/ and the application to M&S	Issues: list/report for current use and for 3–5 years
3. CONOPS for each role in order to serve needs identified in #1. Roles are: FDAd, study director, data center, VV&C system developers, DBAd, Services' data acquisition (deconfliction)	IDEF0

Repository Subgroup Tasks:

1. Organize itself
2. Work with MITRE as subject experts on #1 and #3
3. Review #2
4. Assess, prioritize, and recommend at the end of the MITRE effort

5. COMPLEX DATA TASK FORCE MEETING NOTES

5.1 AGENDA

WEDNESDAY JULY 13, 1994, 0800 – 1700

0830-0900	Review of goals, strategy, accomplishments: Ms. Iris Kameny
0900-1000	Object Oriented Modeling Techniques: Ms. Elaine Ward
1000-1030	Break
1030-1230	C2 Core Model: Dr. Robert Walker
1230-1330	Lunch
1330-1400	Data Modeling Needs for the National Ground Intelligence Center: Ms. Janet Morrow
1400-1430	Discussion of Three Taxonomies: Iris Kameny
1430-1500	Break
1500-1630	Complex Data Categorization Discussion: Mr. Len Seligman and Mr. Peter Valentine
1630 -- 1700	Wrapup: accomplishments, next meeting and goals, etc.

5.2 ATTENDEE LIST

COMPLEX DATA TASK FORCE MEETING
WEDNESDAY, 13 JULY 1994

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5.3 COMPLEX DATA ISSUE DISCUSSION

Ms. Iris Kameny: Review of Goals, Strategy, Accomplishments
Iris Kameny began by reviewing: the organization of the Complex Data Task Force, previous activities, and long term and short term goals. The long term goals are to develop an M&S guideline to data modeling and standardization of complex data types in coordination with CIM. Near term goals are: (1) definition and categorization of complex data; (2) developing complex data models and standards (as well as data modeling techniques and standards) from pilot studies by participating projects; and (3) coordination with CIM as to issues and problems and suggested extensions to data modeling and standards.

The definition and non-exhaustive categories of complex data agreed to in the April 6–7, 1994 meeting can be found in Section 3.4, " Results from I/DB Task Forces and Subgroups", under Mr. Len Seligman: Report from the M&S Complex Data Task Force Subgroup on Categorization.

Items of interest that occurred between the April meeting and this July meeting include: (1) the DMA MC&G standardization effort funded by CIM is underway; (2) the DIRS model definitions paper has been delayed; and (3) the Workshop on Data Representations in Scientific Computation hosted by the Climate System Modeling Group at LLNL will be held at Villa Tassajara, Pleasanton Calif., August 16,1994 (they are addressing things such as grid representations, geometry, units and a host of parameters and attributes currently incorporated into scientific DBMSs and code development environments). Duane Hufford provided an "example metadata model for mapping domain collisions due to data element associations" (that is included in the Appendix).

Issues/briefs that the group wanted to cover during this meeting included: (1) results of the first IEEE Metadata Workshop (2) progress toward development of taxonomies (3) brief and discussion of object-oriented data and OO data modeling; (4) discussion and evaluation of C2 Core Model (5) brief from Janet Morrow on National Ground Intelligence Center

Ms. Elaine Ward: Object Modeling: A Solution to Complex Data Challenges
Most complex data challenges are a result of organizational dynamics and technological advances and will not be solved by object modeling or any other modeling technique. Organizational dynamics affect inter-and intra- organizational data: business process (domain) changes; instance data changes; mappings among different organizational and systems models; data dependencies or business rules; data semantics inconsistencies among data models; and lack of normalization in legacy systems. Technological advancements affect issues relating to data integrity and synchronization: heterogeneous, distributed environments; data interoperability; data sharing; and user access privileges/ownership.

Traditional data modeling techniques are static and associate primitive types (entities) with attributes without capturing semantics. A problem is that instances that do not relate to each other may be compared by accident (e.g., one may try to select or join across data fields that are the same syntactic data type (e.g., character) but are not related, such as name of country and name of organization). Relationships of complex data include inheritance, composition (hierarchies, complex structures, BLOBS).

Key aspects of object orientation are not really agreed to yet but there is general agreement on the following basic concepts for OO. Static characteristics: unique identity; encapsulation (enforced association of attributes and behavior); information hiding; class concept (template that represents common instances); and complex relationships (e.g., inheritance). Dynamic characteristics are: notion of state; message passing; well-defined interface (access through methods); and polymorphism (ability of two or more classes to respond to the same message appropriately).

Important comparisons between data and object models: both models promote reuse and synchronization, promote data sharing and avoid stovepipe systems. There is a difference between the models in focus/scope in that top-level object models have a domain focus problem (often including people and other resources), and conceptual data models tend to focus only on the data to be stored in the database. There are differences in content: object models include problem domain classes, their behaviors and relationships among the objects while data models include mainly entities, attributes and basic relationships (but sometimes include a mechanism for strong typing). She showed an example of entity vs class for a tank where the tank class included an identifier and state that was not present in the tank entity. She also showed how objects could inherit polymorphic attributes through value restrictions on information types in their subsets. OO also enables the modeling of the behavior of data because it can address both static and dynamic characteristics.

Issues: objects are in the eye of the beholder (objects are abstractions that can be used to model various views, or represent large-or fine-grained information) and underlying object models used by different technologies are not necessarily compatible. There are different types of objects (e.g., corporate level objects, subject area domain objects, system architecture objects, analysis and logical design objects, physical design objects, implementation objects) and related models developed with different OO techniques do not easily map to each other nor do models developed with OO and non-OO techniques. The briefing goes into some detail on the problems in relating models in each of these areas.

Summary: (1) mixing and matching of OO analysis and OO design methods takes up front work and is not always seamless; (2) one needs to establish a well-defined process before beginning data modeling activities; (3) pilot studies help in identifying potential approaches; (4) object models can provide significant enhancements over traditional models; (5) to reap benefits from OO one must use proper tools, and ensure that tools and methods can integrate with process and implementation technologies.

Object oriented issue discussion included: (1) concern in confusing class and type; (2) Elaine Ward mentioned a comparison document of OO methodologies that was available from MITRE; and (3) the CCTT domain analysis and DISA/CIM design analysis may have relevance here.

Dr. Robert Walker: C2 Core Model

The purpose of data models is to provide a high-level specification of information inputs and outputs of functional processes, particularly those information items subject to exchange. A data model provides a consistent basis for data element standardization. The C2 Core Model began as the NATO C2 Generic Hub data model. The concept was to define a core C2 data model that could be the common starting point or hub for data models in all C2 subfunctional areas. Each subfunctional area would be an extension to the generic hub.

Dr. Walker briefed during the 2-day I/DBTWG meeting, but agreed to come to this TF meeting and go into more detail about the C2 Core Model. IDA has proven that data models can be developed at the core level and extended. The question being asked by our M&S community, is whether we should start with the C2 Core Model and build our own M&S extension(s).

The C2 Core Model is missing references to certain other models in the functional areas of personnel, logistics, finance and accounting.

Last year the MCEB directed the C2 FDAd to build the C2 Core Model from the NATO Generic Hub model so as to be integrable with the DoD Enterprise Data Model. This required excluding the object-item and object-type concepts from the C2 Core Model. The results of this exclusion has been to explode the C2 Core Model. In data modeling, there is often a tradeoff of precision vs complexity. The current US position is to have precision and complexity.

Location and time are complex concepts with many representations that need to be modeled in the data model.

Location in the DoD Enterprise model is separate from the DMA geo-loc feature for C2. There are hundreds of ways to represent location. The C2 Core Model uses an abstract data type called location with thirty-five different representations. The multiple representations need to be formalized. An example was (1) establish the DMA standard as the DoD standard, (2) establish a UTM "standard", (3) have standard algorithm for translating the standard to UTM, and (4) have standard algorithm for translating UTM to the standard.

Location would only be connected to object items. An associate entity would be used to indicate how location is calculated for an aggregate object (e.g., location of unit could be a geometric weighting, location of commander, etc.). Accuracy would be an attribute of the associative entity while precision would be an attribute of location. For each material and location, there would need to be a key to the different instances of the location code (to translate to different representations).

For signals of an unknown object, "signal" would be a feature of the object. One could keep track in the "material" entity of position and speed or could have position and speed as part of location.

He discussed migration of existing systems to the C2 Core Model. An example is JOPES. One way is to include the whole JOPES model as is and enclose it in dotted lines (as a black box). Another is to define new independent entities in JOPES and integrate those with the C2 Core Model entities.

He discussed logical modeling of point, line, area, polygon. There is only one attribute with coordinates in the data model and that is a point. An associate entity is used to model a line in terms of two points; areas and polygons are handled similarly. An exception is a perforated area, i.e., an area with holes or something missing.

He said that we could replace "location" with other concepts needed by the M&S community for our data model.

He is very interested in having the M&S community and the intelligence community try to use the C2 Core Model and point out problems, lacks, etc. He would like us to think of this as a set of specifications to complete for DoD.

In the Fire Support extension to the C2 Core Model, there is a concept of object type effectiveness (e.g., material type and material type (tank on tank) has a data element Pk that has values). The value is modeled against the two dimensions. A target is the focus of an action against a thing that actually exists. A target doesn't become a thing until it is part of an action. We need to find out more about this way of modeling weapon performance data elements.

The C2 Core Model is the source of all C2 data elements but not of their implementation. The DoD Data Model consists of entities and attributes that have gone through the approval process. The DoD Enterprise Data Model has not gone through the approval process. JOPES + the C2 Core Model have been circulated for comment. The M&S community goal is to integrate our data models with the DoD Data Model in accord with the Enterprise Data Model, using the C2 Core Model as guidance. (He said this, but in practical terms I am not sure what "in accord with" or "as guidance" means.) The C2 Core Model is an option Walker believes we won't get anywhere without; we need to use it to get integration about data M&S needs to use and share with the operational community. We need a strategy to get data requirements into the DoD process. We need to find resources in the DoD community to help us do M&S data modeling.

He said for us to pick a day to work with them and they would try to find the time. The C2 Core Model document is a high level document to use; we may also need something more detailed.

Ms. Janet Morrow: National Ground Intelligence Center
Richard Bernstein has been working with Ms. Morrow on intelligence data for ground systems. They have now joined with the tactics and doctrine center. They deal with data and information at all levels of security.

They distribute their data on CD-ROM and it can be accessed via hypertext links. Their database plan calls for the use of hypermedia to link different types of information such as hypertext documents, weapons characteristics in an Oracle database and an object base. They have complex intramodel relationships. They have the ability to extract data/information from free text using expert system tools. The multimedia information includes combat instruction sets, video, pictures, and graphs. Their C2 database is in template form showing unit, equipment and who communicates with who.

She thinks multiple relationships, aggregations, metadata, dynamic data, etc. all need to be focused to get the information people need. If this were done correctly, one should be able to create, for example, a generic tank object to play in DIS.

Their data quality is usually very good since the analyst knows the area well and may use CAD, engineering models, projections, tests at Aberdeen to do validation. There is a measure of the degree of confidence in the quality of the data. There are four confidence levels: 1 is certain, 4 is an engineering guess. It is often hard to capture the data because of complexity, the data is not in 3NF, and the same data may be in many different categories.

They would like to talk with us more about data models and M&S.

Jim Augins: Discussion
Multimedia data is complex data. He has information on multimedia standards, products, and research. This includes the communication standards used to access multimedia and hypertext information over the internet. He will be publishing a Mosaic page with a Universal Resource Locator (URL) for the repository subgroup. The Mosaic page will include a bibliography of the information he has in his notebooks (multimedia, exchange standards, etc.). His next step is to send out a set of abstracts and URLs over email about multimedia and communication and exchange standards.

Discussion
ODBC is an Open Data Base Connectivity standard agreed to by a consortium of DBMS vendors. It allows access to different DBMS services.

The Microsoft standard uses an object library incorporated into the application. This acts as an ODBC DMS. It is needed to solve SQL incompatibility problems. NIST is involved in these standards.

5.4 SUBGROUP ORGANIZATION

The TF agreed to do away with the Complex Data subgroups leaving the Complex Data Task Force with no subgroups. The TF goals remain the same: to continue to work on data modeling of complex data, guidelines to modeling and standards for complex data, and pilot studies. It was agreed to make the Taxonomy Subgroup issues and goals the responsibility of the Data Standards Task Force Repository Subgroup.

Summary: during the April meeting the TF agreed on a definition for complex data and defined a non-exhaustive list of categories of complex data. During this meeting, it was suggested that

future pilot studies for complex data be selected from among the ongoing M&S projects, e.g., CCTT, UTSS, ARMS, CENTCOM's CFDB. Another possibility suggested at an earlier meeting, is to select Navy and Air Force weapons performance data for pilot studies as a complement to the Army TRAC pilot study and as a way to look at data modeling and standards across a large part of the DoD weapons performance data.

The new effort getting underway for a Joint Simulation System (JSIMS) was discussed. JSIMS will have an object oriented base. There is a need to understand how the object-oriented approach will fulfill the DoD 8320 requirement and IDEF1X data modeling. This TF needs to interact with JSIMS to understand their intent with respect to data.

5.5 FUTURE MEETINGS

There was no future meeting scheduled.

6. DATA STANDARDS TASK FORCE MEETING NOTES

6.1 AGENDA

THURSDAY JULY 14, 1994, 0800 – 1200

0800-0815	Review of past meetings and objectives
0815-0845	Report on Needs for DIS Data Standards paper: MAJ Walt Swindell

M&S REPOSITORY SUBGROUP SESSION

0845-0900	Repository Goals and Strategy: Mr. Jim Augins
0900-1000	M&S Repository Design Discussion: Mr. Mike Gorman
1000-1030	NASA Distributed Active Archive Center (DAAC): Mr. Ken McDonald
1030-1130	Repository issues and next steps: Mr. Jim Augins
1130-1200	Wrapup: led by Iris Kameny

6.2 ATTENDEE LIST

DATA STANDARDS TASK FORCE MEETING

THURSDAY, 14 JULY 1994
0800—1200

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6.3 DATA STANDARDS ISSUE DISCUSSION

Ms. Iris Kameny: Review of Past Meetings and Objectives
Iris Kameny opened the meeting and quickly reviewed the purpose and goals of the Data Standards TF (condensation of what she presented on July 11th at the opening session of the I/DBTWG, her briefing charts are in that Appendix). The Data Standards Task Force has formed two Subgroups: the DIS Data Standards Subgroup chaired by Walt Swindell and Army/TRAC and the Repository Subgroup co-chaired by Jim Augins and Pete Valentine. The DIS Data Standards Subgroup held a meeting in Orlando to organize the writing of a DIS paper to be presented at the September DIS meeting (the paper has been accepted.) The Repository Subgroup held a short meeting during the previous I/DBTWG meeting in February and asked to use most of the time in this meeting for a Repository Subgroup meeting. The first hour of this meeting was devoted to the Data Standards TF and the last 3 hours to the Repository Subgroup.

MAJ Walt Swindell: DIS Data Standards Subgroups
Walt Swindell was scheduled next to speak about the DIS Data Standards Subgroup activities which resulted in the paper "DIS Needs for DoD Data Standards" co-authored by members of the Subgroup. Walt was unexpectedly called back to Leavenworth for the birth of his fourth son and so Iris Kameny presented his brief on the DIS paper. Essentially the purpose of the paper is to convince the DIS community that the DIS PDUs will not be adequate, efficient or cost effective for supporting interoperability among models and simulations. Instead, data standards based on the DoD data modeling and standardization process are recommended. The paper discusses the evolution of data standards, the DIS vision and the lack of data standards in that vision. Advantages of using data standards: cost efficiency in reuse of data and data standards, increased credibility of DIS exercise results, reuse of models, interoperability of M&S and operational world (given operational world will be developing and using data standards), and affect of data standards on use of legacy instance databases. The paper describes the standardization process with examples of IDEF0 and IDEF1X modeling. The paper ends with a vision of DIS using data standards and a suggested roadmap as to what DIS should do in the future.

Dr. Jim Hammond: Security Issue
BFTTs raised a security issue since they are working with DIS but need to use classified data. This issue has been folded into the overall recommendation to DMSO that a new I/DBTWG task force be formed to address data security requirements and get M&S data security requirements to DISA/JIEO/CISS for attention and solution.

REPOSITORY SUBGROUP MEETING

Mike Gorman reminded us that the review of the MITRE M&S Mission Statement part of their repository requirements task was due for review. On 7/29 they plan to send out the IDEF1X diagram of the repository objects and their relationships to each other. He asked how they should send this non-textual material, Apple BINHEX, or? The group decided it should be sent by fax and Jim Augins took responsibility for getting everyone's fax numbers together.

Mr. Kenneth McDonald: EOSDIS Information Management
Pat Liggett from JPL, who is supporting NASA, arranged for this briefing so we could learn more about the DAACs as repositories and benefit from their lessons learned. Ken is at the NASA Goddard Space Flight Center and can be contacted email: ken.mcdonald@eos.nasa.gov

The goals of EOSDIS Version 0, which was started in FY91 during the definition of the EOSDIS Core System (ECS), were: to prototype uniform search and order access to data held at Version 0 DAACs, provide operational capability in July 1994, solicit input from user community during design and operation of Version 0 elements, and gain experience that could be applied to ECS.

When they started up each archive had an existing system and they needed to build a server layer to run on top of each system. They needed to translate everything in the server layer to interface with the client. For in-depth information about datasets, they currently use local interfaces that are unique for each system. They also needed different search aids, e.g., for text, for geographic searches. They still need to get a feel, during the test phase, for how much they can open the system up to users, how much traffic they can accommodate on individual systems, over the network, etc. It took about three years (1991–1994) for Version 0 to become operational. The EOSDIS Information Management System (IMS) V0 is a client/server system.

We can get a paper on V0 lessons learned.

Not all NASA data is accessed through DAACs. There are many smaller sites at universities and labs that can be found through directories and then accessed directly. For access, they are using the Hierarchical Data Format (HDF) as a minimal standard. This is adequate for subsample images, low resolution images, and images designed for browsing but not for high resolution images. Mosaic offers an advantage in browsing and they have also looked at the NEON browser for NEON distributed systems. The intelligence image systems are heading in the NEON direction.

The briefing charts show the architecture. There is a global changes master directory that has brief descriptions, etc., guide information using Mosaic hypertext links to data sets etc., data sets with pointers to granules (smallest unit of data independently managed) and pointers to inventory metadata which contains descriptions of granules and information about how to select and obtain a subset, and then a browse mechanism for browsing granules to aid in selection. The IMS supports directory search, inventory search, guide search, visual aids (graphic displays, retrieve and display precomputed browse products), results integration (sort, merge, and select), and product requests. It is based on a client/server model using a message passing approach. There is reuse of the guide software which is text search and hypertext navigation built on WAIS, WWW, and X-Mosaic. The servers are heterogeneous HW/SW using heterogeneous RDBMS while the clients were developed on multiple Unix workstations but currently running on a single SGI.

Charts: Included in the Appendix for this section are the latest versions of several data models

(1) The DMSO Database Directory Fully Attributed Logical Data Model (IDEF1X) modified by JDBE 8 July 1994

(2) The DMSO Model and Simulation Directory Fully Attributed Logical Data Model (IDEF1X) modified by JDBE 8 July 1994

(3) DIS Exercise Data Model: authors Walt Swindell (TRAC) and Peggy Gravitz (COLSA Corp.), 1 July 1994

Mr. Jim Augins: Presented an outline for the repository meeting
(1) get together a list of issues
(2) prioritize the future things the group needs to do
(3) get organized
(4) decide if this is the right forum for getting together or do we need to create another forum
(5) give Peter a chance to talk: Peter's issue: interoperability of modeling information

Issues

(1) Lack of standards for repositories
— state why FIPS 156 and DDRS are insufficient;

— Chien needs to provide DDRS specifications to JDBE and MITRE in order for them to evaluate the DDRS
— August 19, DDRS steering committee meeting: can Chien attend?
(2) Definition of repository (different kinds of repositories)
(3) There are multiple requirements for M&S repositories
(4) Multiple M&S repository efforts need coordination
(5) Repository needs beyond data models: MITRE (e.g., data centers, M&S reuse repositories, etc.)
(6) Communication standards for repositories
— PDU/DIS, others, internet, classified/unclassified
— how repositories will interoperate, communication standards, networks, system load, etc.
— DIS needs to address this with respect to network distribution of databases for a DIS exercise
— Resources Information Management System (RIMS), Jim Watson will send Iris this document
(7) Short term requirements
— M&S FDAd needs
— Data repository efforts
(8) Physical data model as an end result (schema)
(9) Classification/security releasability issues
— Implementation of a repository as influenced by these issues
(10) Need for multiple repository tools
(11) Implementation issues
— object oriented
(12) Ada usage
— e.g., DMSO and government approval for MEL being programmed in C++
(13) Electronic exchange of metadata
(14) Timeframe schedules for current repository development

Priorities of Efforts for the Next Year

(1) Repository Subgroup Charter
(2) Interoperability across M&S data repositories (i.e., CENTCOM, OASIS, ARMS, etc.)
(3) Repository to support M&S data administration program (asap)
(4) Electronic exchange of metadata and instance data
— standards to use for exchange of metadata and data (new ones, existing ones)
— file formats
— exchange mechanisms
— SIG under DIS
(5) Participate in DIS repository effort

Action Items

(1) Insufficiencies of DDRS: brief DDRS evaluation at meeting in mid-August
— Due date: 1 Aug 94
— Due to: Chien Huo
— Persons responsible: Pete Valentine and Mike Gorman

(2) Insufficiencies of FIPS 156
— Due date: TBD
— Persons responsible: TBD

(3) DIS communication standards: exercise planning, "lessons learned"
— Due date: next meeting on 15 August 1994
— Person responsible: Jim Watson

(4) Draft Charter
- Due date: 31 Aug 1994
- Persons responsible: Jim Augins, Linda Calvert, Pete Valentine

(5) MITRE Task 1 Review (received today)
- Due data: 22 July 1994
- Persons Responsible: see list of Subgroup members

(6) MITRE Task 2 Review
- Fax on 1 August 94
- Due date: 7 August 94
- Persons responsible: see list of Subgroup members

(7) Status of ICASE and DoD Evaluation
- Due date: 15 August 94
- Person responsible: Linda Calvert

6.4 SUBGROUP ORGANIZATION

It was decided to form another Subgroup under this TF. It will be called the M&S Data Standardization Process Subgroup.

Co-chairs are to be:
LtCol Rick Barker (JTAMS)
Linda Calvert (MITRE)

Other members:
Jim Augins
Luci Haddad
Jim Hammond
Mike Hopkins
Iris Kameny
Eleanor Schroeder
Peter Valentine
Jim Watson

The goal of the M&S Data Standardization Subgroup is to provide data standard proposal packages to DoD

I. Issues
1. Where to start?
   a. C2 Core Model
   b. DoD Data Model
   c. M&S Core Model (develop one)
   d. Other
2. Complex data representations to include object-oriented
3. External sources and studies

II. Requirements
1. Implementing 8320
2. Other

III. Pilot studies for information gathering and proof of concept

1. Subject area information (SAI) model for electromagnetics — proposal package
   - database and need standards
   - connects to equipment bucket under Enterprise model

2. Conventional Force Database IDEF1X model address — address how to get to proposal package
   - in process of reverse engineering

3. UTSS reverse engineering simulations (source and requirements for target simulations) and forward engineering — need to develop proposal package
   - based on airframe simulators
   - need to integrate UTSS model and map to data sources

4. CCTT domain analysis and data model

5. SIM World DIS (SPARTA and Jim Watson) just beginning and may be using IDEF1X

6. NWTDB/ARMS: — need to develop proposal package
   - E/R(?) models at campaign level
   - collect information on data elements
   - IDEF1X data modeling

7. E2DIS/JTAMS

IV. Products

1. Policies and procedures
2. Tools and facilities (i.e., repositories)
3. Exchange standards

6.5 FUTURE MEETINGS

The next meeting of the Repository Subgroup will be on August 15–16, 1994 at NRaD in San Diego. Jim Augins will make the meeting arrangements.

There is no scheduled meeting for the Data Standards Task Force at this time nor for the new M&S Data Standardization Process Subgroup. The paper on DIS Needs for DoD Data Standards was accepted and will be presented at the DIS September meeting by Walt Swindell and Iris Kameny.

7. SUBGROUP ON DATA VV&C GUIDELINES MEETING NOTES

7.1 AGENDA

THURSDAY JULY 14, 1994, 1300 – 1700

1300-1330	Review of progress: Bob Hartling and Mark Ralston
1330-1400	DIS Applications Data VV&C Process: Bob Hartling
1400-1445	Non-DIS Applications Data VV&C Process: Mark Ralston
1445-1500	Break
1500-1530	Joint Tactical Missile Signatures Program: LtCol Barker
1530-1545	Summary of IEEE Metadata Workshop: Jeff Rothenberg
1545-1600	Producer Data VV&C Process – What Needs to be Done? Bob Hartling
1600-1700	General Discussion and Wrap-Up

7.2 ATTENDEE LIST

DATA VV&C TASK FORCE MEETING

THURSDAY, JULY 14, 1994,
1300—1700

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7.3 DATA VV&C GUIDELINES ISSUE DISCUSSION

Bob Hartling and Mark Ralston: Review of Progress followed by DIS and Non-DIS Data VV&C Process

The meeting, co-chaired by Mr. Robert Hartling, CNO, and Mr. Mark Ralston, AMSAA, was held on 14 July 1994 at the Institute for Defense Analysis, Alexandria, Virginia. The meeting continued on the following afternoon, 15 July. The objectives of the meeting were to review progress to date and determine future actions for the subgroup.

Mr. Hartling opened the meeting with a review of progress to date. The definitions of VV&C, developed by the group, were reviewed. These definitions, as shown below, have been submitted to the DMSO I/DBTWG for acceptance as standard descriptions of the Data VV&C process. Mr. Hartling then briefed the work that has been accomplished to date on the DIS VV&A/VV&C process flow diagram and "quick planner". After much discussion it was agreed that the DIS process flow diagram would be modified prior to acceptance by the subgroup. The DIS VV&A/VV&C process flow diagram was discussed again on the following afternoon. Mr. Ralston followed with a presentation of a draft Data VV&C process flow diagram for Non-DIS applications. After discussion it was concluded that this process flow diagram did not adequately represent generic Data User VV&C processes and would have to be reworked. Mr. Ralston was followed by LtCol Barker, who presented a briefing on the Joint Tactical Missile Signatures Program and the data VV&C processes followed by this program. Finally, Mr. Jeff Rothenberg presented a report on the first IEEE Metadata Workshop.

After the planned presentations, the group discussed approaches to future efforts. As a result of these discussions the group concurred with a list of products that would result from future efforts (see "Products" below). In order to produce these products, the group decided to concentrate their next efforts on the development of a process flowchart and guidelines for User Data VV&C for Non-DIS applications. In order to accomplish this a plan to develop a User Data VV&C process flowchart was developed and discussed (see "Proposal" below). The group concurred with this approach and the meeting was adjourned.

Products

- Definitions — completed at Data VV&C TF meeting on April 19, 1994:

  Producer Data:

  Producer Data Verification: The use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling.

  Producer Data Validation: The documented assessment of data by subject area experts and its comparison to known or best-estimate values within stated criteria and assumptions.

  Producer Data Certification: Determination by the data producer that data have been verified and validated.

  User Data:

  User Data Verification: The use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and that data are transformed and formatted properly.

User Data Validation: The documented assessment of data by subject area experts and its comparison to known or best-estimate values as appropriate for use in an intended M&S.

User Data Certification: Determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage.

- User Data VV&C
  - — DIS applications
    - Incorporation into process flowchart
    - Incorporation of steps into quick planner
  - — Non-DIS applications
    - Process flowchart
    - Guidelines

- Producer Data VV&C
  - — Process flowchart
  - — Guidelines
  - — Tools and techniques
  - — Quality profile

Proposal to Develop User VV&C Process Flowchart for Non-DIS Applications

I. Decide what the Non-DIS data VV&C process model should represent
   A. What encompasses Non-DIS? Answer: don't exclude initially, get examples from Services, and decide if they are appropriate.
   B. What perspective do we want to represent? Answer: model from a data user perspective.
   C. What functions (if any) do we want to exclude? Answer: model the VV&A process as well as the VV&C process.

II. Task the subgroup Service representatives to prepare IDEF0 process models of representative non-DIS user data VV&C processes.

A. Army	—	Mark Ralston
B. Navy	—	Bob Hartling
C. OSD	—	LtCol Barker
D. JCS	—	?
E. AF	—	LtCol Balombini

III. Meet to compare IDEF0 process models, see if they can be integrated into a general process model.

LtCol Rick Barker: Joint Tactical Missile Signatures (JTAMS) Program
The purpose of this briefing was to gain insight for a potential pilot VV&C implementation. The background of JTAMS is that detailed signature data is required for new warning systems. The AF Electronic Warfare Center maintains extensive signature data and conducted a 1988 survey of missile warning system developers' needs. The result of the survey showed that the community efforts are uncoordinated, standards are lacking and there is a 51% duplication of tests. Data is not transferable, difficult to access and poorly documented. The JTAMS solution is to create standards and a joint data library in which the data can be verified with testing. The JTAMS program objectives are to (1) develop joint standards for describing Tactical Missile Signatures (TMS); (2) develop joint standard procedures for acquiring TMS; (3) develop a Joint Interactive Data Library to promote continued acquisition and dissemination of TMS; and (4) develop a plan to provide for formalized DoD implementation of TMS standards and to ensure future utilization of the Data Library by all the services. JTAMS benefits are for measurement community improvements, high quality data for the acquisition process, improvements in data

archiving, and model improvements. Library will be Oracle Based (Joint Electromagnetic Signatures and Effects Database Library (JESEBEL)) and will do complete signature data management using modular design methodology. The data quality implications are: there is no such thing as "best" data since correctness and completeness are always relative to a particular purpose, and cost-benefit analysis is necessary to decide how much data V&V is worth doing and how much model V&V is worth doing. JESEBEL is a representation of abstract TMS and there could be many different representations. JTAMS promotes TMS quality by recording sufficient metadata about TMS; by controlling and improving the processes that affect TMS; by performing producer and consumer VV&C in terms of its metadata which specifies its intended users and purpose; and by recording the TMS evaluation results in additional metadata.

Mr. Jeff Rothenberg: Summary of IEEE Metadata Workshop held at National Archives May 16–18, 1994
The workshop focused on scientific data and metadata needs: need to share data across disciplines and contexts where data may appear different in different disciplines or contexts; scientific data may have special characteristics (effect of instrumentation, huge datasets); and they need to produce a reference model or framework for scientific metadata. The metadata needs to be machine interpretable, should be useful in allowing systems to help users, should be human-readable, and a standard representation for metadata is highly desirable. Many aspects of data must be represented: non-scientific domains, non-scientific attributes of data such as ownership, privacy, cost, quality, usage, etc.; and the metadata has to serve many different uses. They are beginning by trying to find a suitable modeling formalism and then applying that formalism to a number of contexts to be able to derive a general-purpose metadata model.

The DoD 8320.1-M.3 Draft document: DISA/JIEO/CIM furnished a draft "Data Quality Assurance Procedures", February 1994, is included in Appendix.

7.4 SUBGROUP ORGANIZATION

There is no change in the Subgroup organization.

7.5 FUTURE MEETINGS

The next meeting of the Data VV&C Guidelines Subgroup was tentatively planned for 18 October 1994.

8. DATA VV&C TASK FORCE MEETING NOTES

8.1 AGENDA

FRIDAY JULY 15, 1994, 0800 – 1700

0830-0845	Review of goals and progress: Iris Kameny
	AUTHORITATIVE DATA SOURCES SUBGROUP
0845-0915	Summary of prior meeting and comments on M&S data categories: Bill Dunn
0915 -0945	Data aggregation, security issues, release authority, and recommendations: Allen Hess
0945-1000	Break
1000-1030	Populating the data sources listings format, who does what and when: Bill Dunn
1030-1100	Authoritative data sources, who are they, data contents, data provider, users
1100-1130	Data centers – who are they, what authority do they have, data contents, providers and users responsibilities: George Flax (but he didn't present)
1130-1200	Requirements for the next meeting: Mike Hopkins
1200-1300	Lunch
	DATA VV&C GUIDELINES SUBGROUP
1300-1600	VV&C guidelines and quality profile working session: led by Bob Hartling and Mark Ralston
1600-1700	Wrapup: Iris Kameny

8.1 ATTENDEE LIST

DATA VV&C TASK FORCE MEETING
FRIDAY, 15 JULY 1994

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8.3 DATA VV&C ISSUE DISCUSSION

Iris Kameny: Review of Goals and Process
Iris briefly presented the long term goals and goals of the subgroups to bring everyone up-to-date. This was brief since most had attended the Data VV&C Guidelines Subgroup meeting the previous day. The briefing is in the Appendix.

She stressed Chien Huo's request for a mission statement for the task force and each of the subgroups.

Mr. Bill Dunn: Summary of Prior Meetings and Comments on M&S Data Categories
There is a confusion about data centers that may not be authoritative data sources (e.g., TRAC TADS) and about authoritative data sources (ADSs) that may not have/manage any instance data. What is an authoritative data source? It is a source that is internal to a Service and it is selected or pointed to by the Service as an authority for a particular category of data. Centers may validate data or just verify data they have accumulated and modified. The data taxonomy shows leaf nodes, each representing a data category for which there could be an authoritative data source.

Allen Hess: Data aggregation, security issues, release authority, and recommendations
Release authority issues: (1) the definition of release authority; (2) data centers must have reasonable authority over data they manage; (3) originating authority for release of specific data may not wish to release the control over the data; and (4) a user who has need to know and meets all other requirements for examining the data must be able to gain access to the data. The Appendix contains the briefing which goes into detail on the definition of release authority in DoDD 5230.24/.25. Hess notes that security guidance deals well with classification of data but not with distribution. It is the distribution statement that is missing for datasets that makes release so difficult to accomplish. He suggests that the ADS guidelines should include a statement to the effect that the review process at the data center must ensure there is a distribution statement agreed to by the original authority. Currently at BMDO, data can be transferred to a data center manager without transferring release authority which essentially prevents data center personnel and users from accessing the data. When attempting to obtain release authority, the originating authority (study director) may no longer be available and/or it may involve a lengthy process. Note that when data is released to a data center, it is really released to the authority/responsibility of the data center director but not to others.

How do classified data centers exchange data? Again this requires a distribution policy and procedures. Lessons learned: (1) Directive No. 3240 should require that release authority accompany archive deliverables; (2) each program should compile a list of users with need to know; (3) program classification guidance must be on file at the data center and must contain distribution statement information; (4) use a test case to establish release authority standards; (5) develop standard forms for user data requests and release authority; (6) it is easier to deal with release authority if data is organized by programs; and (7) data centers, study directors, information systems, security, etc. must all participate in release authority solutions.

Also, release authority for experiment/test data must address catalog information, metadata and data since the release authority may be different for these different types of data.

With respect to data aggregation: Hess suggests that a methodology should be designed to determine the probability that one will need to do a detailed examination of data aggregation issues. There could be an algorithm to determine the need for re-examining the classification level of a data aggregation or dis-aggregation. Putting two data elements together is probably not a problem. But if you put 50 additional pieces of data into a threat environment where there already is classified data, then that may be a different story.

The Navy takes data from a highly classified source, aggregates the data and releases it at the unclassified level removing any identification of the originating source(s).

John Coale told of a court case where DIA said they couldn't release aggregated data at the unclassified level even though the individual data was unclassified. However, the court told them to release it as unclassified a single page at a time.

In summary: we need to build standards for release distribution into the process in order to make data releasable and shareable.

Mark Ralston: Authoritative data sources, who are they, data contents, data provider, users responsibilities, and "data on demand".
An authoritative data source (ADS)is an organization designated and recognized as the producer of best-estimate values for one or more categories of data or an authoritative data source is an organization designated to conduct producer VV&C activities for one or more categories of data.

Responsibilities of an ADS include: (1) maintaining subject matter expertise in these technical areas that relate to the data categories that the organization is responsible for; (2) data centers should be producing data to meet the needs of data users either by filling the repository in anticipation of needs or producing data "on demand"; (3) ADSs conduct producer V&V; (4) ADSs prepare data producer certification; and (5) ADSs develop and maintain appropriate database technology to meet the needs of data centers and data users (i.e., data standards and timeliness).

AMSAA has been delegated to be an ADS for equipment performance and characteristic data by AMC. Its mission is to serve as an independent technical evaluator for major systems; perform materiel system analyses; perform logistics analyses; serve as a VV&C authority for equipment performance data; and for model development/VV&A.

TRAC serves as a data distribution center (repository) for data users within TRADOC with AMSAA producing new data only when necessary. Much of the data AMSAA produces is model output using input variables that are often unique for a specific user's need. This requires the ability to generate data of a recognized "standard" type with different input variables "on demand" to support a single data request.

AMSAA has ~100 people involved in data VV&C, while TADS has only 10–15 people.

Mike Hopkins: Requirements for next meeting

DMSO Issues/Things to Do for ADS and ADS Process:

(1) IDEF0 models for Services VV&A "as-is" process are needed. There may be many of these per Service (depending on how many different ways the VV&A process is carried out). Especially need support on integrating IDEF0 models (may need AI support for this).
(2) Need a data model for an Authoritative Data Source Directory
(3) Need to address security issues, in particular, data aggregation and release authority.
(4) Need to complete the ADS guidelines document.

Things to Do for the Next ADS Meeting:

(1) Nail down the data category matrix: everyone send comments to Walt Swindell and Howard Haeker and let's go another round with it and get a quick response.

(2) Need subset of data center people to look at that: CENTCOM, TADS, OASIS, ARMS, AF needs to nominate a data center, and NWTDB.
(3) Answers to who are the ADS, where are they, what are their responsibilities and how do they connect to producers and users: get DISA or OSD survey of data centers.

Bob Hartling and Mark Ralston: VV&C Guidelines Meeting (continued from previous day)
The study/exercise directors make decisions as to M&S VV&A. DIS VV&A working group is coming up with recommended studies for VV&A. The Components are defining their VV&A processes. AR 25-9 discusses VV&A for the Army.

Issues in Response to Chien's Request:
(1) Pilot studies for VV&C Guidelines: should be 5–6, need to pick the right diversity of projects
(2) AI tool support for VV&C using quick planner for non-DIS
(3) DIS exercise director's tools to coordinate data for all M&S used in an exercise (think that ARPA is doing this for DIS)
(4) For producer data VV&C process models, suggest using DMA and Navy Oceanographic databases as examples

Simone Youngblood: DIS VV&A
DIS exercise takes place at the entity level and provides everyone with ground truth of the virtual battlefield. Every M&S has its own data representations. They will have a common database for an exercise (e.g., for terrain data). Each M&S must be VV&Aed and each contains data that is not passed to it by PDUs.

DIS repository: There is a basic need for a DIS repository to be used when building an exercise. It is where the exercise director goes to find pointers to M&S and M&S data. DIS needs catalog type of information. DIS needs a distributed directory and needs to keep past VV&A information and pointers to Components repositories. The DIS exercise directory needs to include references to: lay down, threat, V&V, Component pointers to M&S and to standard databases; and fidelity information (there is a whole fidelity taxonomy that would include the level of resolution). The Components would input data into the repository when they go through compliance testing of M&S. (Note, compliance testing only assures that they are producing correct PDUs, it says nothing about validity.) Past exercise reports would also go into the DIS repository.

8.4 TASK FORCE ORGANIZATION

No change in the Data VV&C Task Force organization.

8.5 FUTURE MEETINGS

Next meeting of the Authoritative Data Sources Subgroup will be held on September 9, 1994 at IDA.

Next meeting of the Data VV&C Task Force and the VV&C Guidelines Subgroup will be held on October 18–19, 1994 at IDA.

APPENDIX A: MAIN I/DB MEETING BRIEFING CHARTS

DMSO

presented at the

Information/Data Base Technology Working Group Meeting

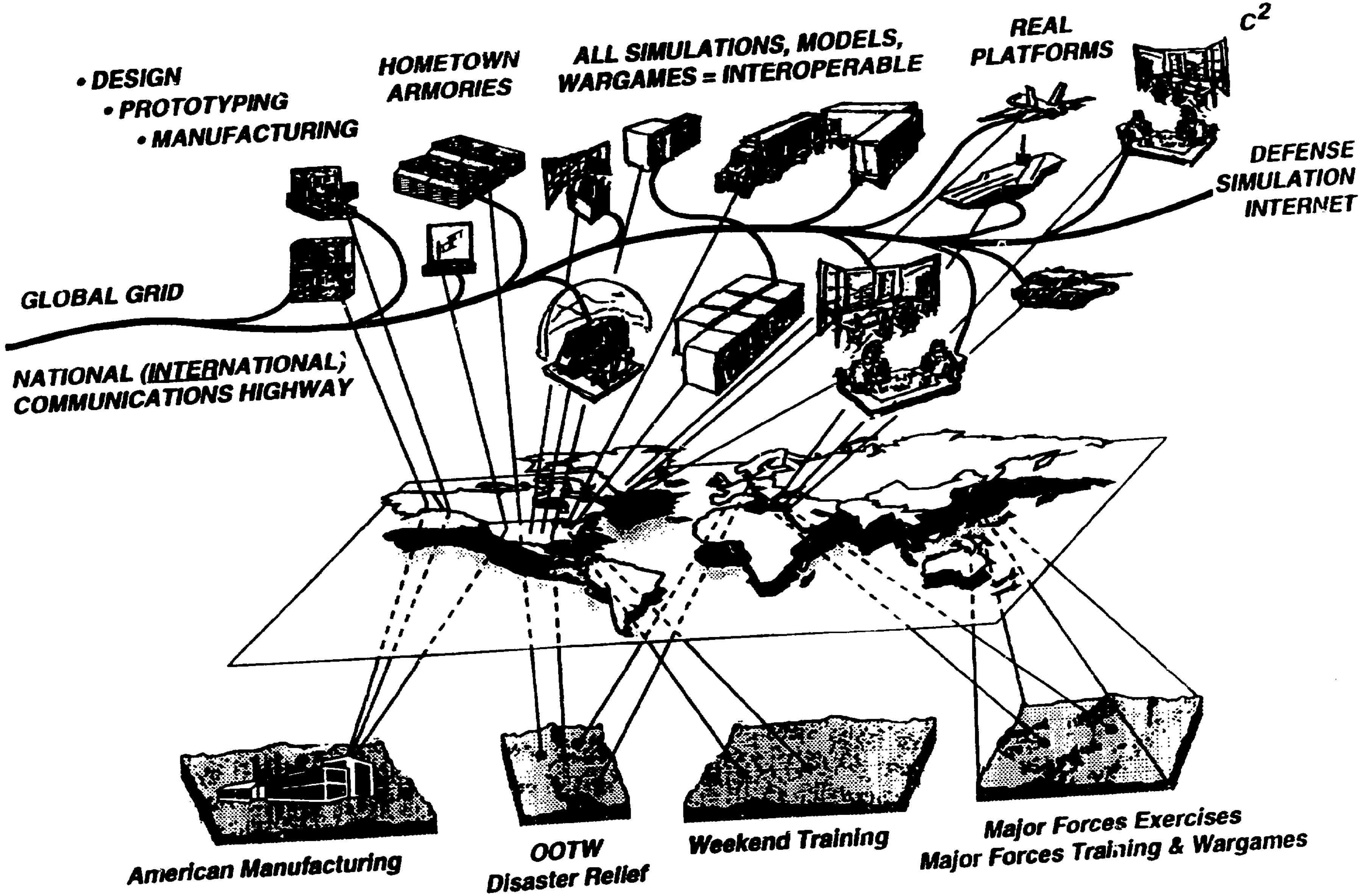
Defense Modeling and Simulation Office *(DMSO)*

Update

11 July 1994

LTC(P) Jerry Wiedewitsch, USA
Deputy Director, DMSO

Examples of Synthetic Environments



MMP.SynEnv.Ver Maj For.lgl
17 Jun 94

REFORGER '94/ ATLANTIC RESOLVE STOW-E

DMSO

European-based Force

Exercise in Confederated Simulation

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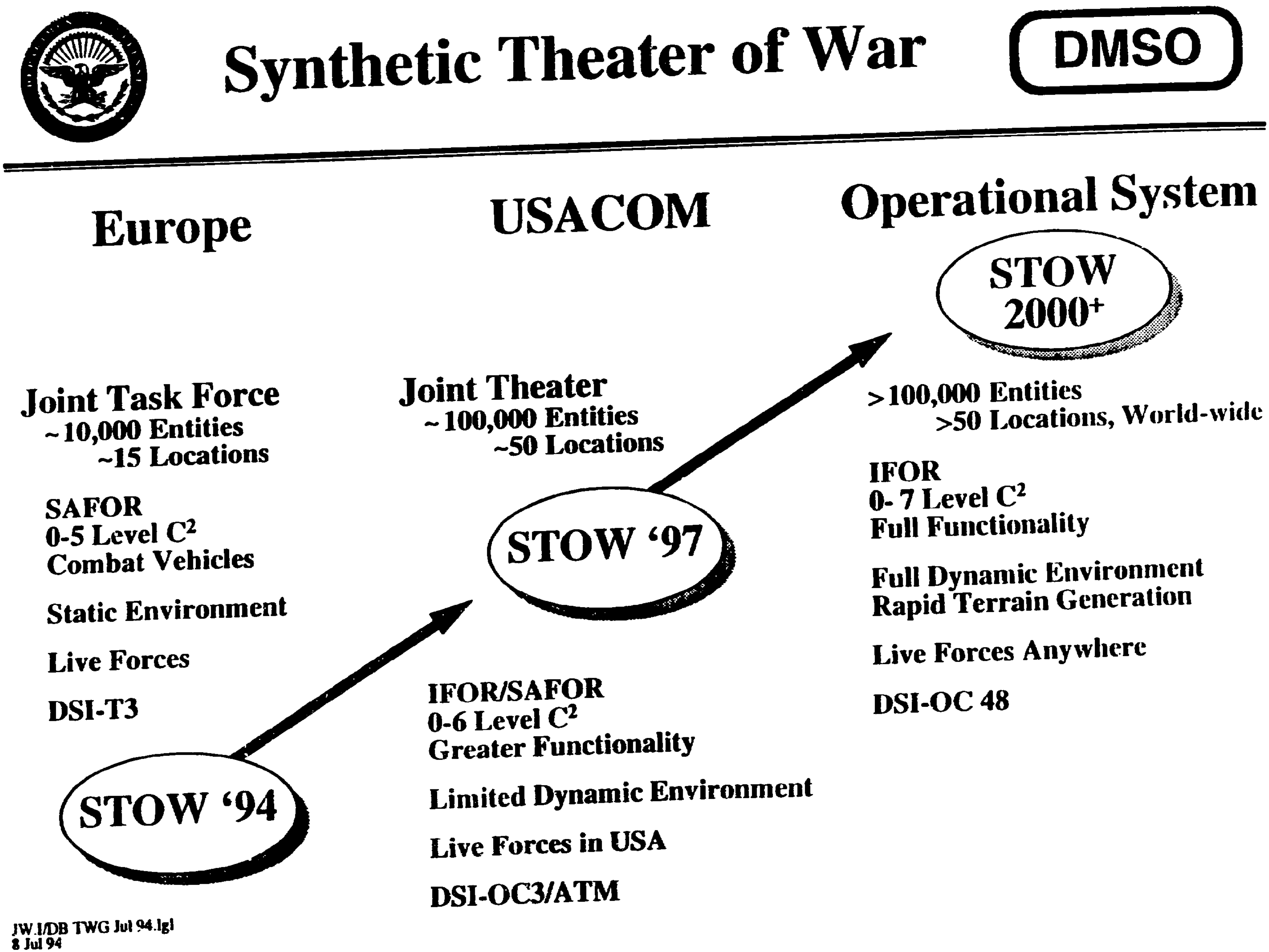
8 Jul 94

3


Synthetic Theater of War
DMSO
Europe
USACOM
Operational System
STOW 2000+
Joint Task Force
~10,000 Entities
~15 Locations
SAFOR
0-5 Level C2
Combat Vehicles
Static Environment
Live Forces
DSI-T3
STOW '94
Joint Theater
~100,000 Entities
~50 Locations
STOW '97
IFOR/SAFOR
0-6 Level C2
Greater Functionality
Limited Dynamic Environment
Live Forces in USA
DSI-OC3/ATM
>100,000 Entities
>50 Locations, World-wide
IFOR
0- 7 Level C2
Full Functionality
Full Dynamic Environment
Rapid Terrain Generation
Live Forces Anywhere
DSI-OC 48
JW.I/DB TWG Jul 94.lgl
8 Jul 94
4

Topics

DMSO

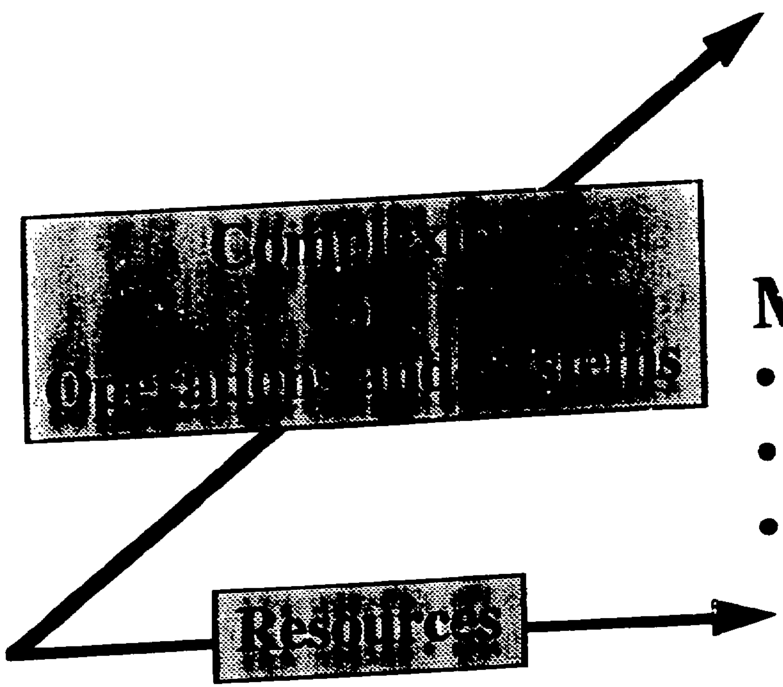
- Readiness
  - Senior Readiness Oversight Council
  - Defense Science Board Readiness Task Force
- JSIMS *(An Architecture for the Future)*
- Technology Area Plan *(TAP)*
- DoD M&S Objectives
- M&S Master Plan

5

Readiness
The Problem: Complexity

DMSO

Increased complexity demands more practice, more prototypes, and more experimentation, which the budget does not permit



M&S can bridge the gap by...

- **Expanding training horizons**
- **Developing a new acquisition paradigm**
- **Exploring new technologies**

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DMSO

Readiness

- **Senior Readiness Oversight Council** ***SROC***
  - **DDR&E Member**
- **Readiness Working Group** ***RWG***
  - **Director, DMSO participates**
- **Defense Science Board Readiness Task Force**
  - **Major support of M&S for joint training and readiness**

JSIMS

DMSO

- Joint Service Common Architecture Project
  - MOA being staffed - 3 Service signatures completed
  - Services forming Joint Program Office
  - Initial product to be architecture for next generation constructive wargames
- Service lead - Strong OSD joint staff and support

x

Technology Area Plan
TAP

DMSO

- Revised S&T strategy *(currently in draft)*
- Guides long term S&T investment
- M&S is separate technology area
- Interactions with over 50% of the other Technology Areas

DMSO

Master Plan

- Focus on Readiness
- Coordinated with TAP
- Builds common vision across entire M&S range of DOD
- Includes technical assessments
- Action plans to build interoperability and jointness and to fill voids
- Basis for investment strategy
- Updated annually

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8 Jul 94

DOD is pursuing Simulation as a Strategic Technology

DMSO

- Simulate before you build
  - Concepts
  - Requirements
  - Prototypes
- Simulate before you buy
  - Testing and Evaluation
  - Develop doctrine
  - Confirm tactics and techniques
- Simulate before you fight
  - Mission rehearsals
  - Integrate actual C^2 systems into wargames
  - Train commanders and staffs

Help the warfighter fight smarter

2 M

DMSO

presented at the

Eighth Information/Data Base Technology Working Group *(I/DBTWG)* Conference

Modeling & Simulation
Data Administration

11-12 July 1994

DMSO
1901 N. Beauregard Street, Suite 504
Alexandria, Virginia 22311
(703) 998-0660
(703) 998-0667 fax

Dr. Chien Huo
DMSO & JIEO/CFS
Ms. Iris Kameny
Rand Corporation

DMSO Objectives

DMSO

1. Provide Technical Framework for Modeling & Simulation
2. Develop Authoritative Representations
3. Integrate Live, Virtual, and Constructive Simulations
4. Broaden Modeling & Simulation Applications

[illegible]
7 July 94

2

Over Arching Purpose *of the* DMSO Data Related Activities

DMSO

To promote interoperability, sharing and reuse of data and models

- In coordination and/or compliance with DISA/JIEO/CIM
- Through data standardization and data related efforts not being addressed by the current Corporate Information Management *(CIM)* initiative, or the commercial world
- With participation and concurrence from the M&S community through M&S projects and components' M&S offices

3

M&S Functional Data Administrator (FDAd) Responsibilities

DMSO

- Implement a M&S Data Administration *(DA)* infrastructure and to establish community consensus on policies, procedures and standards
- Address complex data standardization, data verification, validation and certification *(VV&C)*
- Establish a M&S repository and the development of taxonomy, Databases Directory and M&S Directory
- Identify and promulgate DA methodology and tools
- Facilitate interchange of information and lessons learned

4

Near Term Actions

DMSO

- Develop Guidelines for data standardization policies and procedures including complex data and VV&C for M&S community
- Oversee task groups addressing complex data, M&S data standards, data VV&C, and DMSO funded database projects
- Develop a prototype M&S repository built upon the Defense Information Repository System *(DIRS)* & Industry Standards to support DA standardization
- Develop M&S Directory *(catalog)* and Database Directory *(catalog)* and Authoritative Data Sources Directory
- Support information sharing, issue, definition and pursuit:
  - I/DBTWG
  - Task Forces
  - M&S Information System *(M&SIS)*

I/DB TWG Structure, Task Forces, and Subgroups

DMSO

I/DB Technology Working Group

- Complex Data Task Force
  - Categorization and guidelines *(JDBE, MITRE)*
  - Taxonomy *(RAND, J-8)*
  - Complex data pilot studies
- Data VV&C Task Force
  - Quality profile and guidelines *(N812D, AMSAA)*
  - Authoritative data sources *(MISMA, CENTCOM)*
  - VV&C pilot studies
- Data Standards Task Force
  - Repositories *(NRaD)*
  - DIS data standards *(TRAC)*

M&S Data Administration Policy, Procedures and Standards

DMSO

- Data Standardization
  - Developing a Data Administration Strategic Plan *(DASP)*
  - Rapid Data Standardization Guidance
- Major areas addressed
  - Policy, procedures, tools for modeling and standardizing complex data
  - Plans for developing M&S repository to contain
    - Complex data standards
    - Domain nomenclature and symbology standards
    - Tools to manipulate and interoperate between repository objects
  - Guidelines and responsibilities for Authoritative Data Sources
  - Guidelines and tools for carrying out Data VV&C including a database quality profile

7

M&S Directory *(Catalog)* and Data Base Directory *(Catalog)*

DMSO

- Data Models for both directories will be available for reuse throughout M&S community
- Data models include taxonomies to aid in browsing and access
- Prototype implementation to be completed by early calendar year 1995 *(with some population of directories)*
- World Wide Web's MOSAIC as a browsing and query tool starting March 1995

I/DB Portion of M&S Information System

DMSO

- Calendar and agendas for future I/DB and related Task Force meetings
- Notes from previous meetings
- Special sections for Task Force *(Complex Data, Data Standards, Data VV&C, Repository)* information
- Membership list
- Information technology relevant definitions, acronyms, and references

Data VV&C Task Force Long Range Objectives

DMSO

- Develop guidelines for performing Data VV&C coordinated with VV&A
  - Definitions and process
  - Cost models and cost information
  - Quality profile and metadata definitions
- Address authoritative data sources and their responsibilities
- Address role of M&S data centers between data sources and simulation centers

Authoritative Data Sources
Draft Paper

DMSO

Draft paper "Authoritative Data Sources for DoD Modeling and Simulation Applications" ***(April 19, 1994)***

Addresses

- **Service agency names and authoritative sources according to mission functionality**
- **Data Centers with customers and functionalities they serve**
- **Potential opportunities for sharing and reuse**
- **Responsibilities of data centers and data customers**

Complex Data Challenges

DMSO

- **Definition** ***(Preliminary, from the April 6-7, 1994 meeting of the Complex Data Categorization Subgroup)***
  - **Complex data is that data which is difficult or awkward to model using commonly used techniques** ***(i.e., IDEF1X and other kinds of Entity-Relationship modeling)***
- **Dependencies**
  - **Active: Age**
  - **Genealogy audit trail: Radar Pulse-Repetition Interval (PRI)**
- **Mapping** ***("maps to/from")***
  - **Inter-model: Radar PRI**
  - **Intra-model: Age**
  - **Derivation: Radar Pulse-Repetion-Frequency**
- **Artifacts of legacy systems and cost constraints**
  - **Multipurpose: e.g., Vehicle-Capacity**
  - **Coupled: e.g., Sex-Marital-Code**

Summary

DMSO

- M&S Data Administration/Standardization Program is a developing area.
- Need your assistance *to facilitate M&S community in data standardization*

DMSO TWG Jul 94
7 July 94

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Points of Contact

DMSO

- DMSO PM for Data Related Activities: CDR Gary Misch
  Phone: (703) 998-0660 Email: gmisch@dmso.dtic.dla.mil
- M&S Data Administration: Dr. Chien Huo
  Phone: (703) 998-0660 Email: huoc@dmso.dtic.dla.mil
- M&S Directory and DB Directory Data Models: Mr. Steve Matsuura
  Phone: (602) 538-4967 Email: matsuuras@huachuca-emh17.army.mil
- M&S Directory and DB Directory Implementation: Dr. Mike Frame
  Phone: (703) 845-6668 Email: frame@ida.org
- Access to M&S Information System: Mr. Ken Wimmer
  Phone: (703) 279-3778 Email: kwimmer@dmso.dtic.dla.mil
- Complex Data, Data Standards and Data VV&C Task Forces: Ms. Iris Kameny
  Phone: (310) 393-0411 x7174 Email: kameny@rand.org
- Complex Data Categorization Subgroup: Dr. Len Seligman
  Phone (703) 883-5975 Email: seligman@mitre.org
- Taxonomy Subgroup: Ms. Iris Kameny (and LtCol Dan Hogg)
  Phone: (310) 393-0411 x7174 Email: kameny@rand.org
- VV&C Guidelines: Mr. Bob Hartling and Mr. Mark Ralston
  Hartling Phone: (703) 695-3797 Ralston Phone: (419) 278-5344
- Authoritative Data Sources: Mr. Bill Dunn and Mr. Mark Hopkins
  Dunn Phone: (703) 607-3386 Hopkins Phone: (813) 828-6430, 6210
- Repositories: Mr. Jim Augins Phone: (619) 553-~~0000~~ 2623 Email: augins@nosc.mil

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7 July 94

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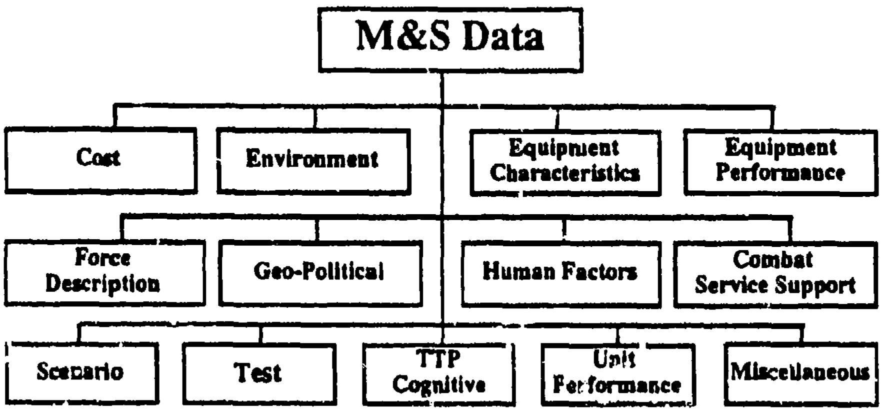
DMSO

Backups

DMSO

Draft Taxonomy for M&S Directory



Definitions of Data VV&C

DMSO

- VV&C Definitions *(April 19, 1994)* from Data VV&C Task Force Meeting at IDA
- Producer Data
  - Producer Data Verification
    the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling
  - Producer Data Validation
    the documented assessment of data by subject area experts and its comparison to known or best-estimate values within stated criteria and assumption
  - Producer Data Certification
    determination by the data producer that data has been verified and validated

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Definitions of Data VV&C

DMSO

continued

- VV&C Definitions *(April 19, 1994)* from Data VV&C Task Force Meeting at IDA
- User Data
  - User Data Verification
    the use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and that data are transformed and formatted properly
  - User Data Validation
    the documented assessment of data by subject area experts and its comparison to known or best-estimate values as appropriate for use in an intended M&S
  - User Data Certification
    determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage

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Authoritative Data Sources
Problem

DMSO

- No Service organization is in place to serve as comprehensive authoritative data source for that Service
  - Authorized sources
    result of instructions or directives that authorize funding for organizations and describe in detail what the organization is to do, what areas it has cognizance over, and what authority it has
    (e.g., DMA, DIA)
  - De facto sources
    become authorities because of the information they possess
    (e.g., Air Force Logistics Command at Wright Patterson, Ships Parts Control Center at Mechanicsburg PA, Army TRADOC Analysis Center (TRAC) at Ft. Leavenworth)
  - Factors contributing to multiple authorities:
    resolution and aggregation, classification

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Authoritative Data Sources
Responsibilities

DMSO

- Use of data modeling and data standards
- Carrying out of data VV&C
- Configuration management of data and processes producing data
- Help to M&S users of data
- Handling of data security issues such as data aggregation
- Participation in M&S VV&A

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Complex Data Categorization

DMSO

Definition of complex data *(Preliminary)*

Complex data is that data which is difficult or awkward to model using commonly used techniques *(i.e., IDEF1X and other kinds of Entity-Relationship modeling)*

from the April 6—7, 1994 meeting of the Complex Data Categorization Subgroup

Complex Data Challenges

DMSO

- Dependencies
  - Active: e.g., update Age each time Current-Date changes
  - Genealogy audit trail: Radar-Pulse-Repetition-Interval comes from EWIR version 1.5 last changes on 01 Jan 94
- Mapping *("maps to/from")*
  - Inter-model: Radar-PRI in Model A is the same as Radar-Pulse-Interval in Model B
  - Intra-model: Age depends on Current-Date and Birth-Date
  - Derivation: Pulse-Repetition-Interval in Model A is the reciprocal of Pulse-Repetition-Frequency in Model B
- Artifacts of legacy systems and cost constraints
  - Multipurpose: e.g., Vehicle-Capacity may contain either number of passenger or weight carrying capacity depending on vehicle type
  - Coupled: e.g., Sex-Marital-Code bundles information on a person's Sex and Marital-Status in a single data element

Categories of Data meeting the definition of Being "Complex" *(Non-Exhaustive)*

DMSO

- Inheritance ("is-a")
  a relationship in which one or more subclasses "inherit" all the attributes and relationships of their super-classes
- Composition ("has a", "is a part of")
  data entities comprising instances of data which relate to other instances of data within the same entity
- Derivations ("comes from")
  data that is computed from other data that is stored in the same or in other databases

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Inheritance ("Is-A")

DMSO

Vehicle
Is-A / Is-A
Wheel Vehicle / Track Vehicle

- IDEF1X supports inheritance using the concept of category
- Complex data need more powerful notions of inheritance
  - Multiple inheritance
    given class has multiple super classes: *e.g., grad-student-assistant is subclass of student and employee both of which are subclasses of people*
  - Multiple Is-A hierarchies
    hierarchies have no common root *(tank is a vehicle and tank is a weapon)*
  - Polymorphic attributes
    an attribute has different interpretations within Subclasses of a common Is-A hierarchy *(Vehicle-Speed expressed in different units of measure for different kinds of vehicles)*

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Composition
("has a", "is a part of") DMSO

Composition M&S data is awkward to represent using relational or IDEF1X concepts

- **Directed graphs such as command hierarchies, bill of parts**
- **Construction/complex structures**
  such as road networks, compound documents
  - **extensible set of data types**
    e.g., binary large objects (BLOBS)
  - **chains**
    e.g., address made up of street, city, state, code
  - **other types of construction**

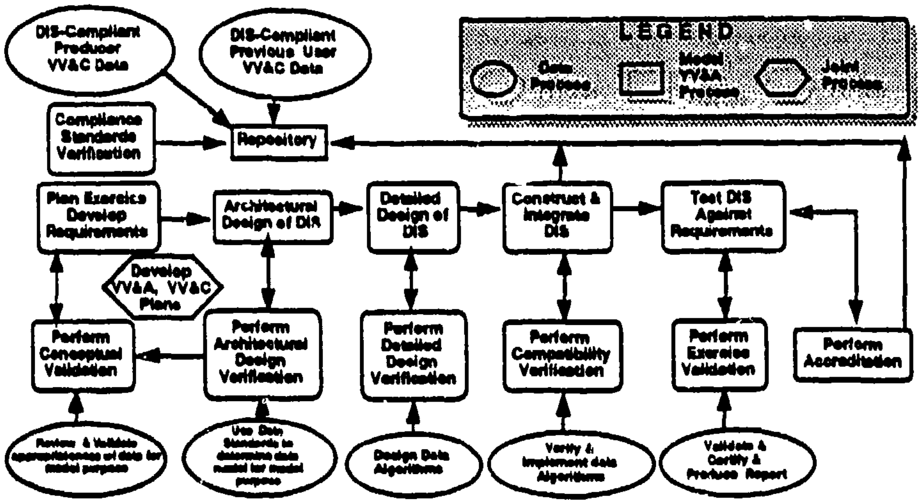
Derivations
("comes from") *e.g., age, Pk* DMSO

Algorithms

- **Within instances**
  e.g., Age of a single PERSON
- **Across instances (aggregations)**
  Average-Age of all PERSONS
- **Stated explicitly**
  e.g., J:=X**2+Z
- **By reference**
  using Euler's equations
  i.e., the internal workings of the algorithm are not described

Data VV&C as part of the DIS Process

DMSO



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7 July 94 27

Database Quality Profile

DMSO

- Comes from VV&C audit trail metadata from all levels
  - Database (DB) level: certifies V&V applied to the DB as a whole
  - Data-element level: certifies V&V applied to data elements and their domains
  - Data value level: certifies V&V applied to individual data values
- V&V audit trail information is open-ended
  - Specifies who has done what, when, to verify/validate/certify the data
  - Applies to data values, metadata values, data-element definitions, and the DB as a whole
  - Represents both producer and user V&V

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Data Administration for the M&S Functional Area

USAEPG

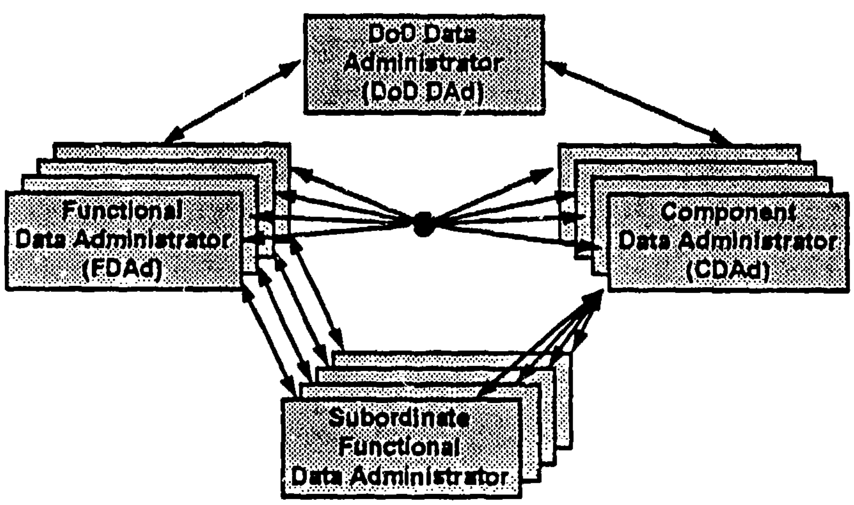
Presented by

Steve Matsuura,
US Army Electronic
Proving Ground

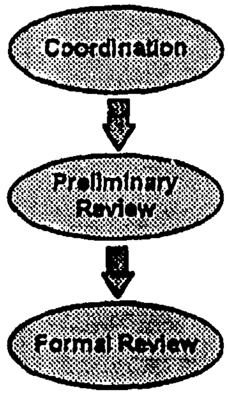
JDBE
Joint Data Base Elements
for Modelling & Simulation

DoD Data Administration Framework

USAEPG



Prime Word and Data Element Approval Process

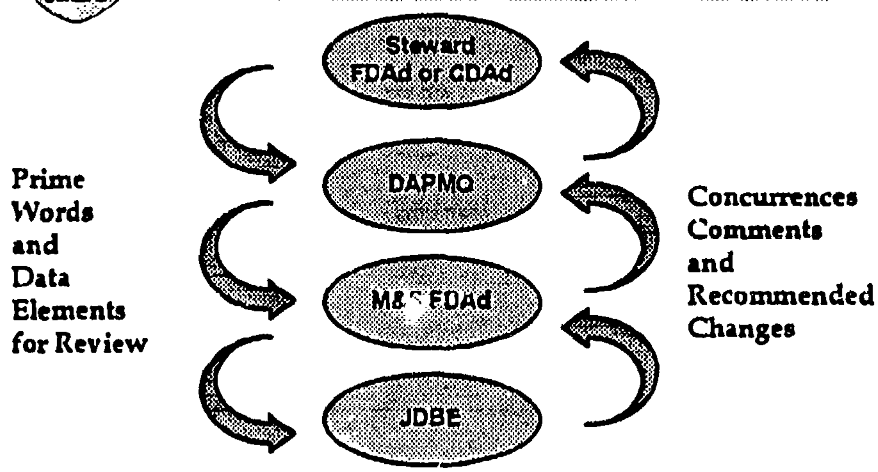


Coordination: FDAd or CDAd reviews the data element to ensure it complies with the rules of DoD 8320.1-M-1.

Preliminary Review: FDAd or CDAd reviews the data element to ensure it fits in a data model mapped to the DoD Data Model and enters it as a candidate in the DDRS.

Formal Review: Steward FDAd identified; cross-functional and technical reviews performed by other CDAds and FDAds.

JDBE Support to M&S Data Administration



Reviews Supported by JDBE

Subject	Organization	Action
Science & Technology Starter Set	USD(A)	Changes Suggested
Military Personnel Conceptual Data Model (5 Submissions)	USD(P&R)	Changes Suggested
C2 Core Data Model (5 Views and Stakeholder's Meeting)	DISA	Changes Suggested

Reviews Supported by JDBE (continued)

Subject	Organization	Action
Corporate Logistics Data Model (Starter set and 1 View)	USD(Logistics)	No Comment
DoD Finance and Accounting Data Model (3 Views)	Comptroller	No Comment
Geospatial Data Model	DISA	Pending
Entity Labeling and Definition Guidelines	DISA	Changes Suggested

Improvements Needed in the Review Process

- Packages sent directly to reviewers designated by the FDAds and CDAds
- Submissions sent via electronic media
- All submissions accompanied by a data model
- Comments submitted via the Defense Data Repository System (DDRS)

Data Administration for the M&S Functional Area

3 M

Bob Hartling

DATA VV&C TASK FORCE

- TASK FORCE
  - IRIS KAMENY
- GUIDELINES SUBGROUP
  - MARK RALSTON
  - BOB HARTLING
- AUTHORITATIVE DATA SOURCES & DATA CENTERS SUBGROUP
  - BILL DUNN
  - MIKE HOPKINS

Long Range Objectives for Data VV&C
(April 19, 1994)

- Develop guidelines for Data VV&C including:
  - Definitions and process
  - Cost models and cost information
  - Quality profile metadata definitions
- Address authoritative data sources and their responsibilities
  - Needs to include authority to certify someone else's data (e.g., AMSAA certifying TADS data)
- Address the role of M&S data centers between data sources and simulation centers

Data VV&C Meeting Objectives
(April 19, 1994)

- Discuss process for determining authoritative users, responsibilities of authoritative users and data centers, and agree on next steps
- VV&C definitions: agree on definitions, on process for approving definitions to make them official, and the next steps in doing so
- VV&C process leading to guideline
  - Agree on data VV&C process related to DIS VV&A process, and on process for making this official
  - Identify other functional area VV&A processes (e.g., analysis) that the Data VV&C process needs to be related to, and next steps
- Certification profile: discussion of metadata needed to describe quality, IEEE Metadata Working Group and workshop, next steps

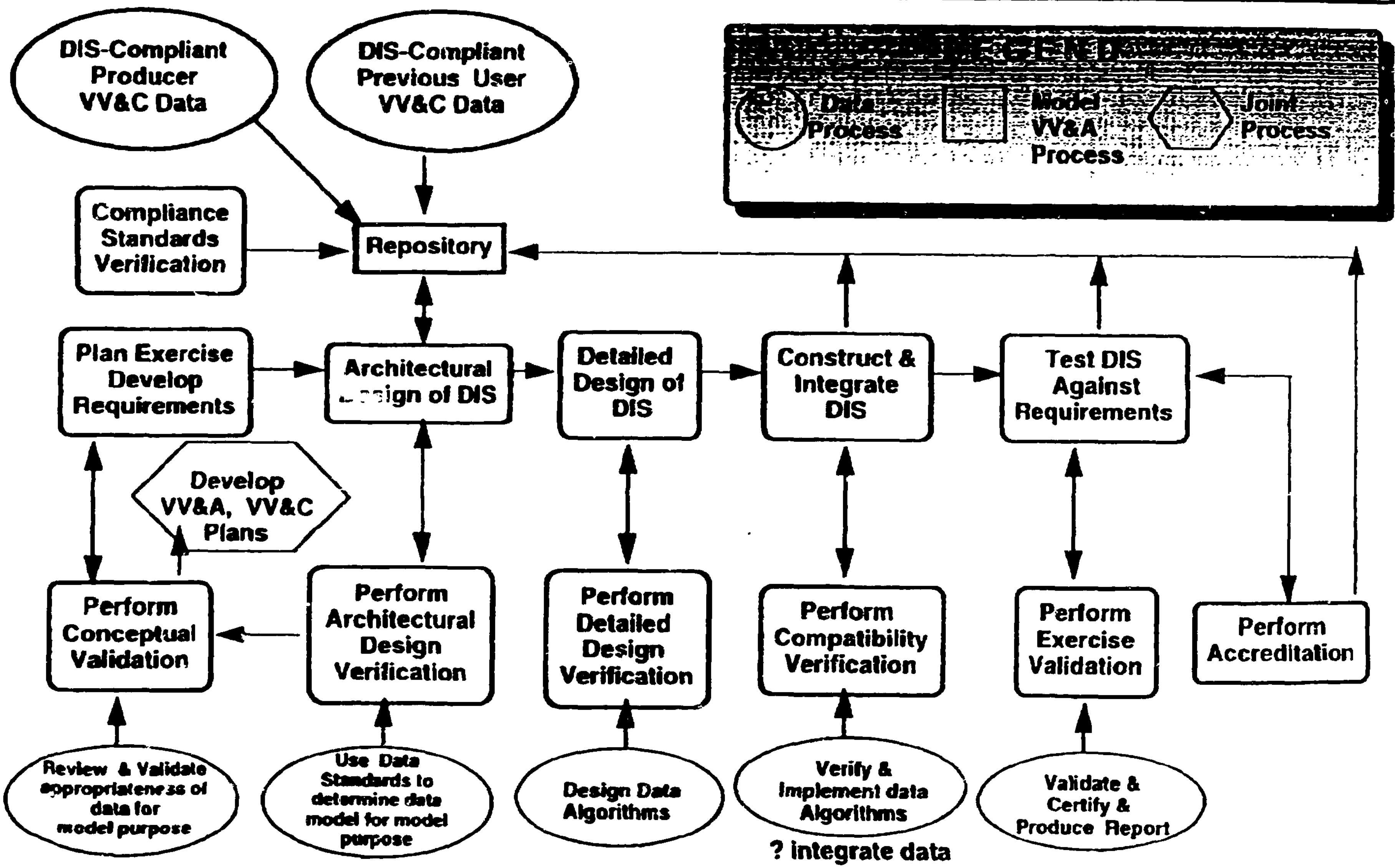
VV&C DEFINITIONS

- PRODUCER DATA VERIFICATION: THE USE OF TECHNIQUES AND PROCEDURES TO ENSURE THAT DATA MEET CONSTRAINTS DEFINED BY DATA STANDARDS AND BUSINESS RULES DERIVED FROM PROCESS AND DATA MODELING.
- PRODUCER DATA VALIDATION: THE DOCUMENTED ASSESSMENT OF DATA BY SUBJECT AREA EXPERTS AND ITS COMPARISON TO KNOWN OR BEST-ESTIMATE VALUES WITHIN STATED CRITERIA AND ASSUMPTIONS.
- PRODUCER DATA CERTIFICATION: DETERMINATION BY THE DATA PRODUCER THAT DATA HAVE BEEN VERIFIED AND VALIDATED.

VV&C DEFINITIONS

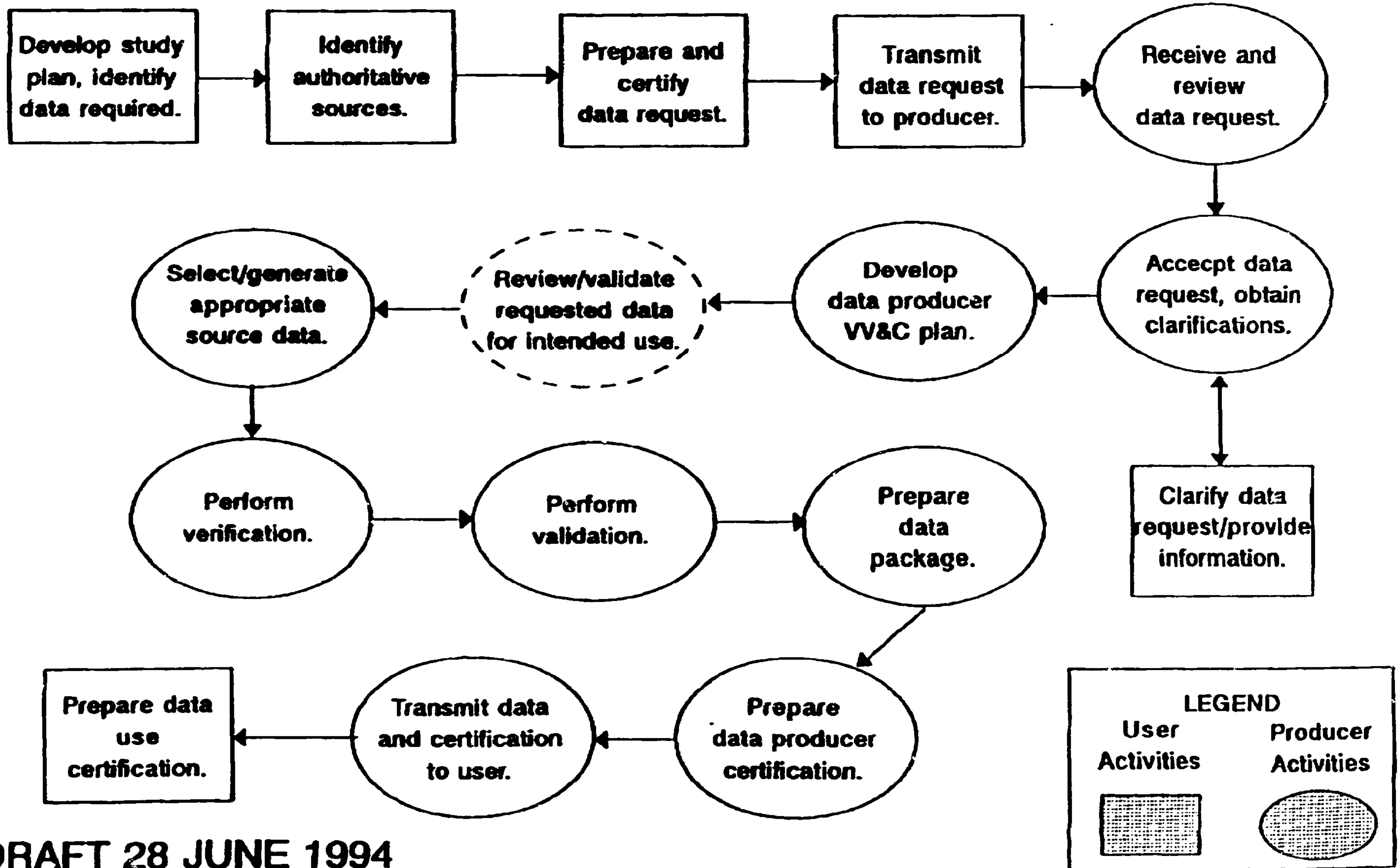
- USER DATA VERIFICATION: THE USE OF TECHNIQUES AND PROCEDURES TO ENSURE THAT DATA MEET USER SPECIFIED CONSTRAINTS DEFINED BY DATA STANDARDS AND BUSINESS RULES DERIVED FROM PROCESS AND DATA MODELING, AND THAT DATA ARE TRANSFORMED AND FORMATTED PROPERLY.
- USER DATA VALIDATION: THE DOCUMENTED ASSESSMENT OF DATA BY SUBJECT AREA EXPERTS AND ITS COMPARISON TO KNOWN OR BEST-ESTIMATE VALUES AS APPROPRIATE FOR USE IN AN INTENDED M&S.
- USER DATA CERTIFICATION: DETERMINATION BY THE APPLICATION SPONSOR OR DESIGNATED AGENT THAT DATA HAVE BEEN VERIFIED AND VALIDATED AS APPROPRIATE FOR THE SPECIFIC M&S USAGE.

DISTRIBUTED INTERACTIVE SIMULATION
COMBINED MODEL VV&A — DATA VV&C PROCESS



DATA VV&C PROCESS

NON-DIS APPLICATIONS



DRAFT 28 JUNE 1994

4 M

Report of the VV&C Task Force

Authoritative Data Sources Subgroup

Presented to the I/DB

11 July 1994

WILLIAM H. DUNN
U. S. ARMY M&S MANAGEMENT OFFICE

Authoritative Data Sources Subgroup Taskings

- Provide agency names and relationships for authoritative data sources which are authorized or perceived as authorized.

- Provide agency names and responsibilities of data centers.

- Address sharing and reusing of data between/among these data sources and centers.

- Address responsibilities of data customers.

Authoritative Data Sources Task Force Members

WILLIAM H. DUNN	ARMY M&S MGT OFFICE
MIKE HOPKINS	CENTCOM
BOB HARTLING	NAVY N812
LTCOL BALOMBINI	AIR FORCE XOM
MAJ SWINDELL	ARMY TRAC
HOWARD HAEKER	ARMY TRAC
MARK RALSTON	ARMY AMSAA
ELEANOR SCHROEDER	NAVY OCNGRPHIC
LCDR FLAX	NAVY SPAWAR
JOHN COALE	DIA
DAVE DANKO	DMA
ROB WRIGHT	RCI CORP
SIMONE YOUNGBLOOD	JOHNS HOPKINS
ALLEN HESS	BRA CORP
BILL BURCH	ISA CORP
LINDA CALVERT	SRA CORP

Accomplishments

Prepared a draft document on 19 April 1994

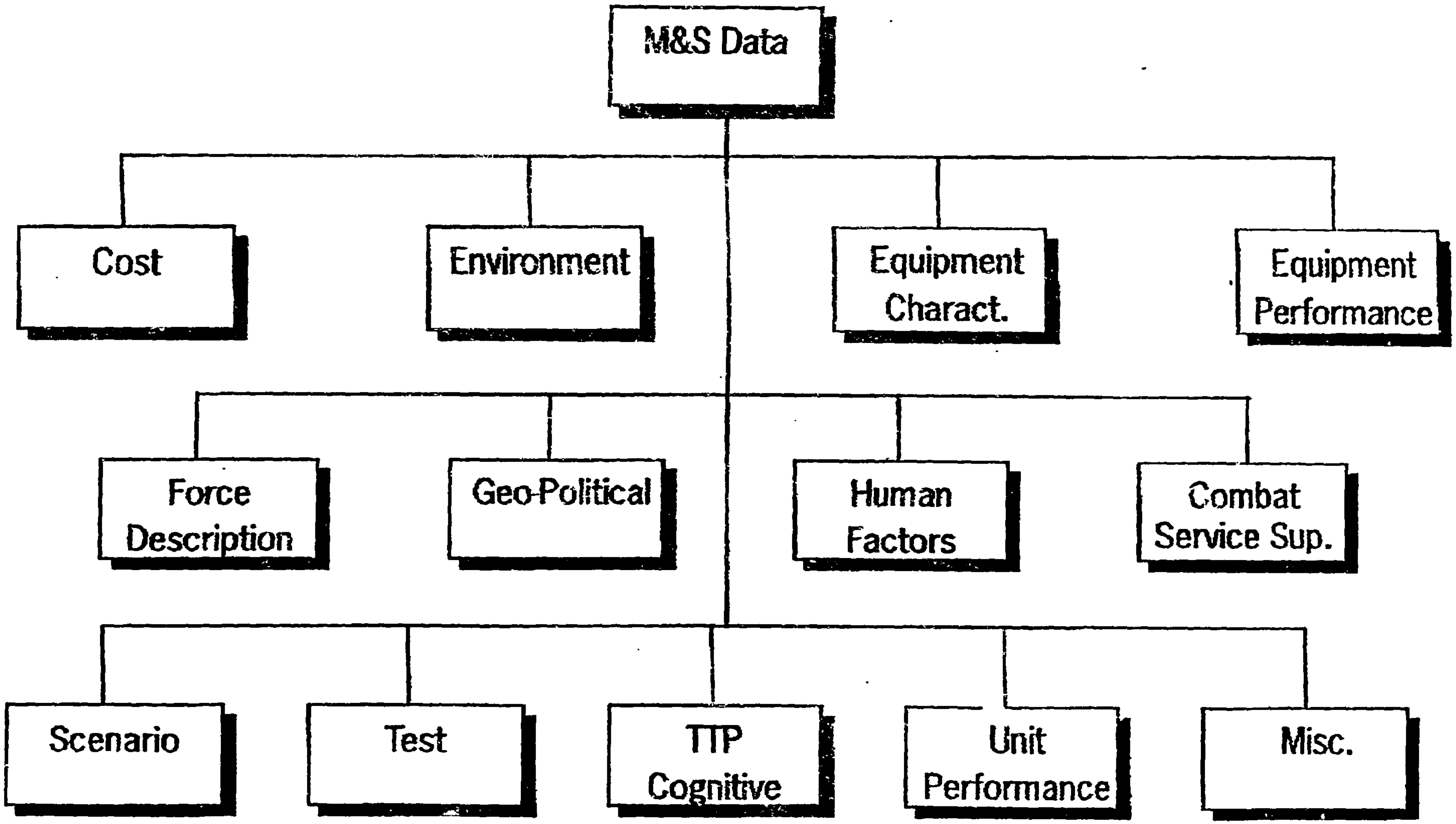
- No Service agency serves as a comprehensive source
- Discussion on sources, authorized and defacto
- Sources identified for Services, CENTCOM
- Responsibilities of data center, data customer
- Multiple entries required due to data aggregation

Future Work

- Presently staffing a data source taxonomy
- Taxonomy will be Service extensible
- Population of the taxonomy
- Security and data release authority guidelines
- 19 April 94 document to evolve
  - Policy and management issues
  - Passed to DMSO/IAC for maintenance

M&S Data Categories

These categories are applicable to the US and Foreign Countries.



5 M

Complex Data Categorization Subgroup

Len Seligman

11 July 1994

MITRE

Subgroup Goals

- Develop categorization of "complex data"
- Provide feedback to relevant groups on modeling of complex data
  - M&S repository efforts
  - Defense Integrated Repository System (DIRS)

MITRE

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Accomplishments

- Developed categorization (April 1994 meeting of Complex Data Categorization Subgroup)
- Gave feedback to Jeff Wolfe (DISA/JIEO/DAPMO) on preliminary version of DIRS model

MITRE

Complex Data Categorization

- Definition of complex data:
  - Data which is difficult or awkward to model using commonly used techniques (i.e., IDEF1x and other kinds of Entity-Relationship modeling)

    (From the 6 to 7 April 1994 meeting of the Complex Data Categorization Subgroup)

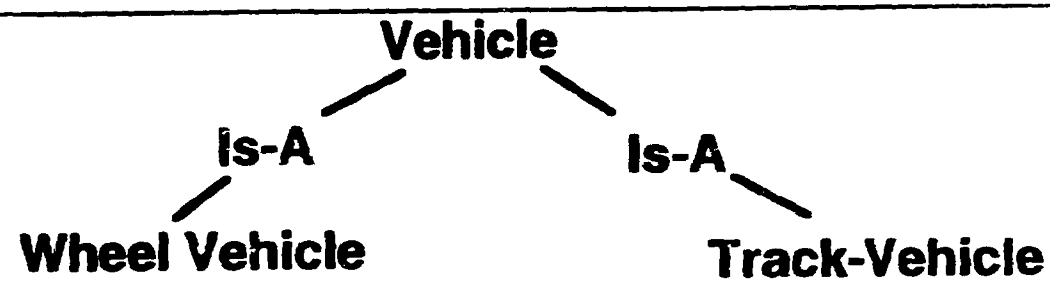
MITRE

Categories of Data Meeting the Definition of Being "Complex" (Non-Exhaustive)

- Inheritance
- Composition
- Derivations
- Mappings
- Artifacts of legacy systems

MITRE

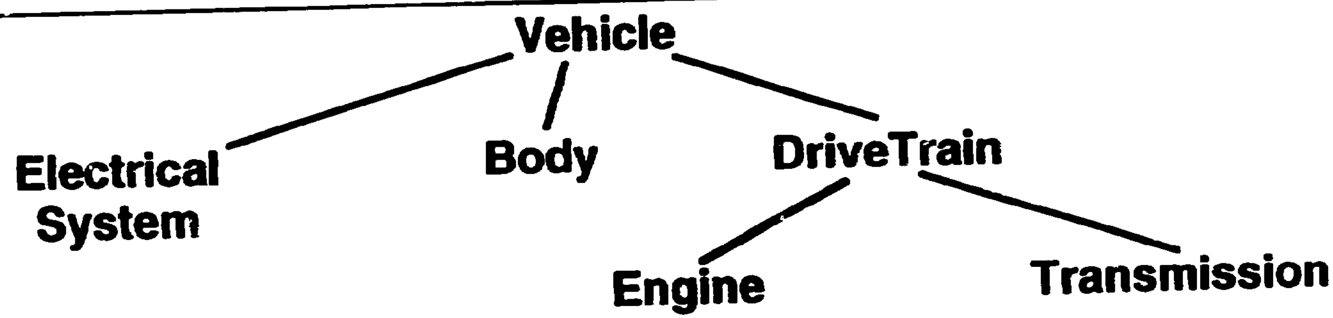
Inheritance ("Is-A")



- IDEF1x supports inheritance using the concept of category
- Complex data need more powerful notions of inheritance
  - Multiple inheritance: a class has multiple super classes: e.g., Student-assistant is subclass of Student and Employee both of which are subclasses of Person
  - Multiple Is-A hierarchies: hierarchies have no common root (e.g., Tank is a Vehicle and Tank is a Weapon)
  - Polymorphic attributes: an attribute has different interpretations within Subclasses of a common Is-A hierarchy (e.g., "capacity" for different kinds of aircraft could be in number of people, pounds of cargo, or gallons of fuel)

7/8/94 4:31 PM

Composition ("has a", "is a part of")



- Directed graphs such as command hierarchies, parts assemblies
- Constructions/complex structures: such as road networks, compound documents
  - extensible set of data types: e.g., binary large objects (BLOBS), Object Linking and Embedding (OLE) objects
  - chains: e.g., address made up of street, city, state, code
- Compositions can be represented using relational or IDEF1X concepts, but *resulting model can be difficult to grasp*

MITRE

7/8/94 4:31 PM

Derivations ("comes from") e.g., age, PK

- Algorithms
  - Within instances: e.g., Age of a single PERSON
  - Across instances (aggregations): Average-Age of all PERSONS
  - Stated explicitly: e.g., J:=X**2+Z
  - By reference: using Euler's equations (i.e., the internal workings of the algorithm are not described)
- Dependencies
  - Active: "Who do I need to notify?"
    - domain changes (e.g., new legal value for a code)
    - schema changes (e.g., concept was represented in a single attribute, now it's a separate table)
    - instance data changes (e.g., new equipment table)
  - Genealogy audit trail: Radar-Pulse-Repetition-Interval comes from EWIR version 1.5 (last changes on 1 January 1994)

MITRE

Mapping ("maps to / from")

- Assertions about how attributes or entities map to other attributes or entities
  - Can be intra-model or inter-model
    - Intra-model: Threat-Location and SAM-loc are the same thing
    - Inter-model: Radar-PRI in Model A is the same as Radar-Pulse-Interval in Model B
  - Can describe equivalence or required conversions
    - Conversion: Pulse-Repetition-Interval in Model A is the reciprocal of Pulse-Repetition-Frequency in Model B

MITRE

Artifacts of legacy systems and physical constraints

- Data which are not inherently complex, but which are complex because of how they have been modeled
  - No one-to-one correspondence between a data element and a single concept being modeled
- Examples
  - Multipurpose: e.g., Vehicle-Capacity may contain either number of passengers or weight carrying capacity depending on vehicle type
  - Coupled: e.g., Sex-Marital-Code bundles information on a person's Sex and Marital-Status in a single data element
- Described in detail in "Data Standardization and Data Reuse Guide for Complex Data Elements"

MITRE

Conclusions

- Developed categorization of complex data
- Next steps:
  - Assess appropriateness of different modeling techniques (IDEF1x, object-oriented, etc.) for complex data
  - Continue discussions on DIRS, other relevant repository efforts
  - Next meeting: Wednesday

M 6

Eighth Modeling and Simulation I/DB Task Group Meeting

Report from M&S Data Standards Task Force Including Taxonomies

Iris Kameny — July 11, 1994

Meetings

November 16-18, 1993: MORS SIMDAT Minisymposium

February 15, 1994: Data Standards Task Force Meeting at IDA

April 20, 1994: Data Standards Task Force Meeting at IDA

July 14, 1994: Data Standards Task Force Meeting at IDA

Structure of Data Standards Task Force

Data Standards Task Force

- Repositories
  - — Co-chair: Jim Augins
  - — Co-chair: Peter Valentine
- DIS Data Standards
  - — Chair: Army TRAC (Walt Swindell)

MORS SIMDAT Mini-Symposium
November 16-18, 1993

— Standards development: need, continued use, conformance, enhancements

— Need to incentivize use of standards rather than strict enforcement

— Recommendation: to form a Data Standards Task Force

RAND

February 15, 1994: Data Standards Task Force Meeting

Discussed Scope and focus of group

- Need data definition standards, metadata standards, and standards for exchange of metadata and diagrams
- Possible focus areas include: coordination of standards development, data models, repository, standard libraries (data sources), data classification

Special assignments:

- What's Available and Where: Pete Valentine
- Coordination of Data Standards Across and within DoD: Luci Haddad
- Generic/Specific Data Models and Lessons Learned: Roy Scrudder
- Reuse Library Framework: Luci Haddad
- Repository Subgroup: Jim Augins

April 20, 1994: Data Standards Task Force Meeting

Presentations owed:

- Luci Haddad: Coordination of data standards across and within DoD
- Peter Valentine: What's available and where
- Jim Augins: Data model interchange standards

Presentations expected and given:

- Roy Scrudder: Generic/specific data models and lessons learned (but much of this was from the Complex Data Categorization meeting and in addition he briefed on capturing metrics for data standardization)
- Luci Haddad: Reuse Library Framework (RLF)

Addition: Luci Haddad gave a brief on the 6th Annual Software Technology Conference held in Salt Lake City, UT

Five Issues Suggested for Data Standards Task Force to Address in Addition to Repository Subgroup

1. Paper to DIS on data standards base for PDUs: underway (W. Swindell, L. Haddad, I. Kameny)
2. Data model for DIS enumeration document: underway JDBE
3. M&S policies and procedures for data standards: Chien Huo/DASP
4. Starter set of data elements for M&S: Chien Huo/DASP
5. Develop M&S corporate view of shareable databases and standards based on Components' requirements: given to Authoritative Data Sources Subgroup

Status

Formed DIS Data Standards Subgroup: held one meeting at Orlando on May 24th to discuss writing of "DIS Needs for DoD Data Standards"

- Paper writing underway
- Should hold meeting after DIS meeting (if paper accepted) to determine next actions

No meeting of repository group: urgent that this be done to coordinate with MITRE study

DIS Needs for DoD Data Standards

Position paper for submittal to next DIS meeting

- DIS vision and its inadequacy with respect to data standards
- Evolution of data standardization
- DIS problems addressed by data standards
- Data standardization process using DIS specific examples
- Future vision of DIS using data standards
- Need for roadmap

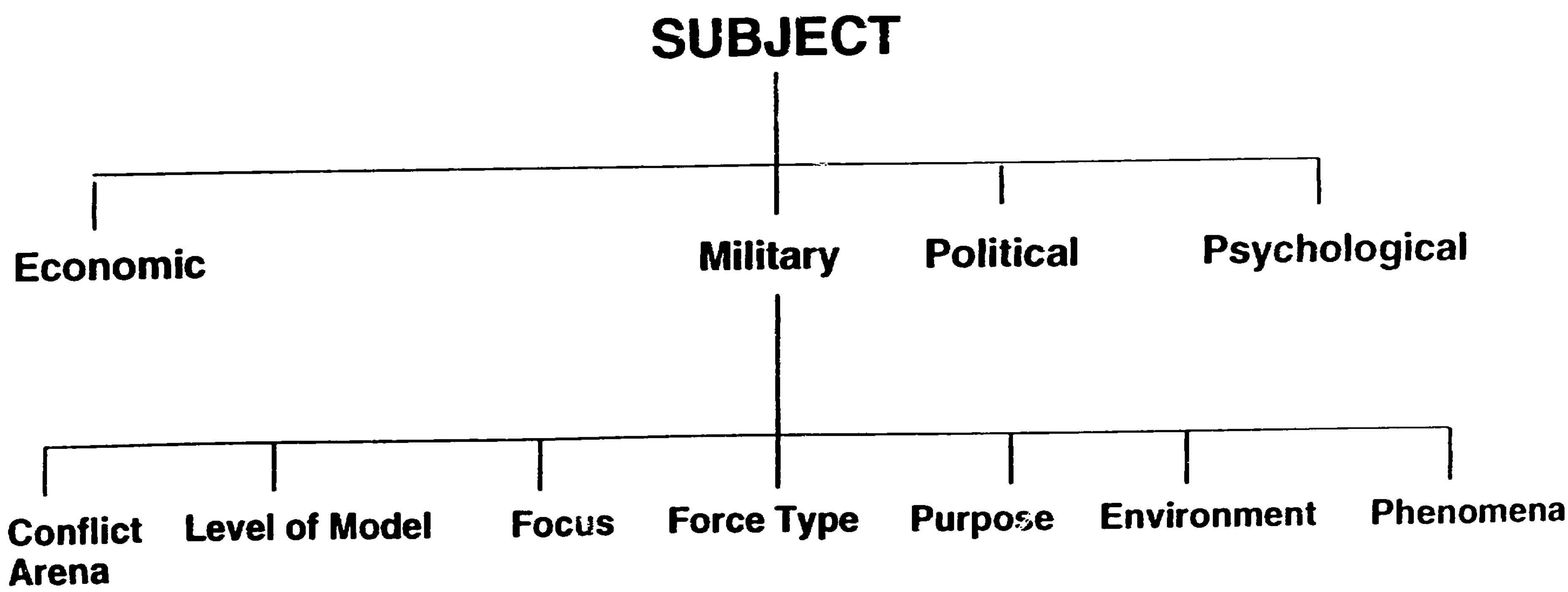
Repository Concepts for DoD M&S Master Plan

- Phased development of M&S Information Resource Repository System (IRR): design, prototype, operational, initial distributed, distributed
- Distributed M&S Information Resource Repository System
  - To enable rapid access, acquisition and processing of quality, consistent, valid data and other information resources for use by models and simulations
  - Based on a minimal set of standards, conventions, and common tools (standards bases: e.g., IRDS2/PCTE2 or DIRs or ?? if possible)
  - To be implemented and tailored for use by M&S organizations, data centers, and projects and collectively accessed as a distributed repository system
  - May contain: process and data models and standards, nomenclature and symbol standards, directories (for M&S and databases), algorithms, databases, models and simulations, common and specialized tools

Taxonomies

- Immediate need for taxonomies: Database Directory, M&S Directory, Authoritative Data Source Categories
- There is a taxonomy subgroup under the Complex Data Task Force co-chaired by Iris Kameny and LtCol Dan Hogg
  - No meetings have been held yet
  - Rand developed initial taxonomies for the directories (May '94 e-mail describing taxonomies and definitions)
  - TRAC took the Army M&S data categories and the RAND data taxonomy and integrated them into a taxonomy for Authoritative Data Source categories (June fax from TRAC describing taxonomy and definitions)
  - More discussion at the Complex Data Task Force Meeting on July 13

Draft Taxonomy for M&S Directory (RAND)



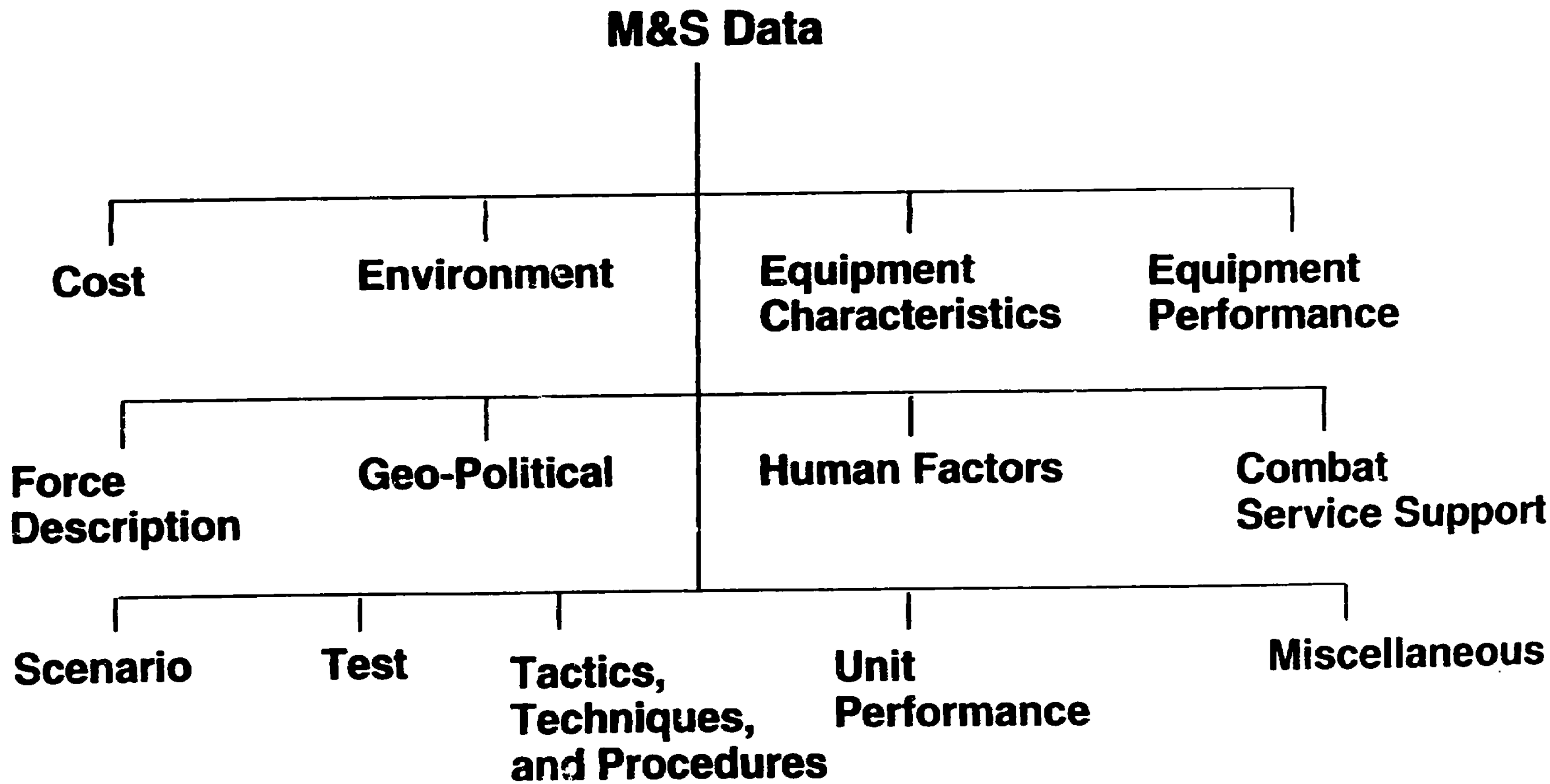
Draft Taxonomy for Database Directory (RAND)

Categories of Information in Military Databases

- Order of Battle
- Geo Political
- Engineering Characteristics
- Performance Characteristics
- Environment
- C3I
- Infrastructure
- Scenario
- Operational
- Resources
- Nomenclature
- US/Foreign

M&S Data Categories (Army/TRAC)

These Categories are applicable to the US and Foreign Countries



M 7

I/DB Task Group Meeting

M &S Directory and Database Directory Progress Report

work done on behalf of DMSO by

The Institute for Defense Analyses

Presented By

Michael Frame

July 11, 1994

IDA

- Status
- Current Activities
- Plan for Completing Project

IDA

Status

Task	Description	Due	Status
1	Complete Logical DB Design (Roy Scrudder)	3/94	Complete
2	Initial Physical DB Design and Implementation (IDA)	3/94	Complete
3	Final Physical DB Design and Implementation	6/94	In process
4	Support DB Population	12/94	In process
5	Support DB Query and Browsing	03/95	In process
6	Transition Support	06/95	

- **DB to go production in early CY1995**

IDA

Current Activities

- Refining Physical DB Implementation
- Evaluating and Processing Army MOSAIC data
- Designing paper data capture "forms"
- Evaluating electronic data formats
- Evaluating World Wide Web's MOSAIC (W3 MOSAIC) as a browsing and query tool
- Schedule remaining tasks

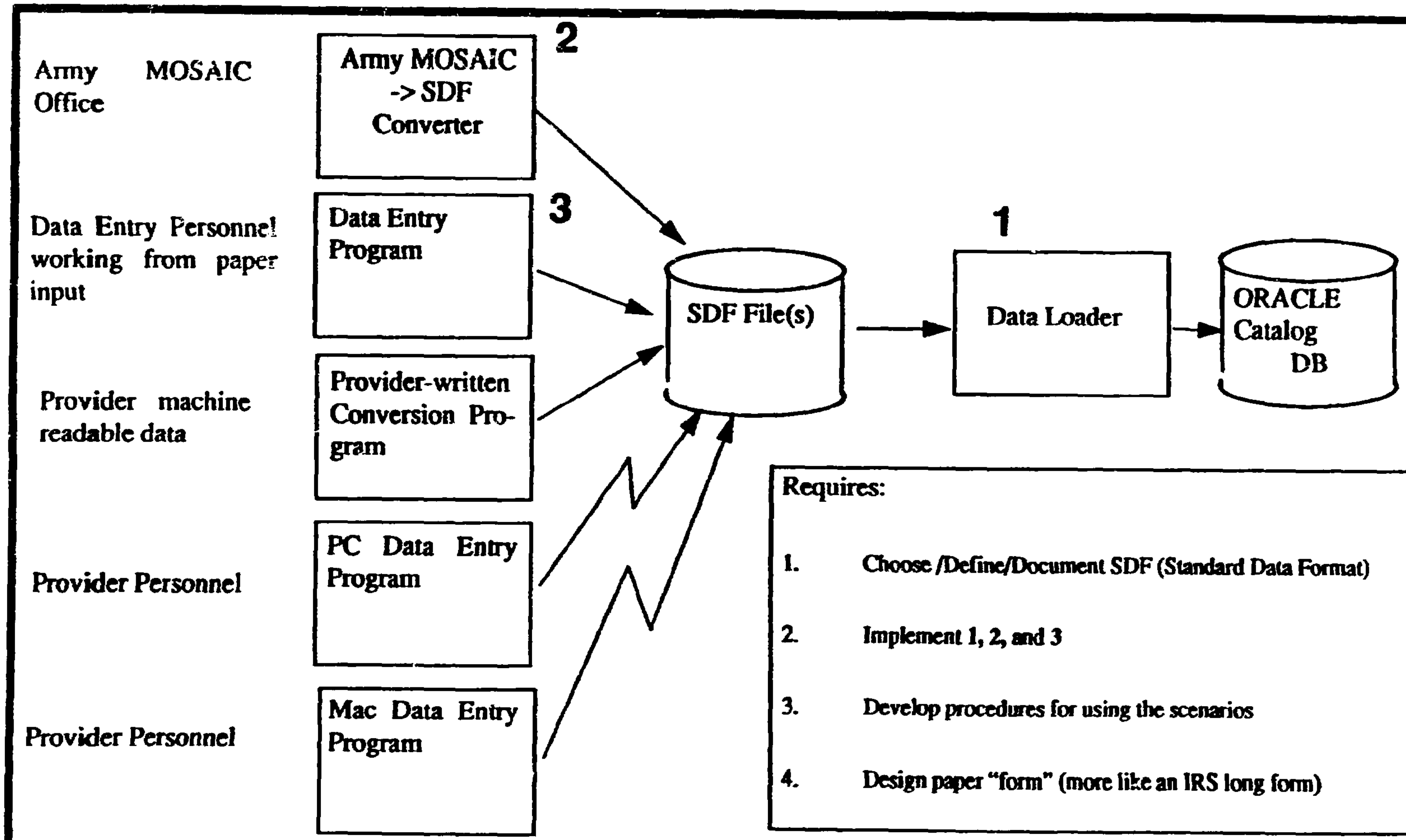
IDA

Plan for Completing Project

- Complete design of paper data entry form
- Complete evaluation of file format alternatives (HDF, Complex HDF, netCDF, HTML, X.500?, others?)
- Complete evaluation of W3 MOSAIC as a browsing tool
- Acquire list of standard queries and reports
- Develop set of browsing paths

IDA

Data Loading Scenarios



Requires:

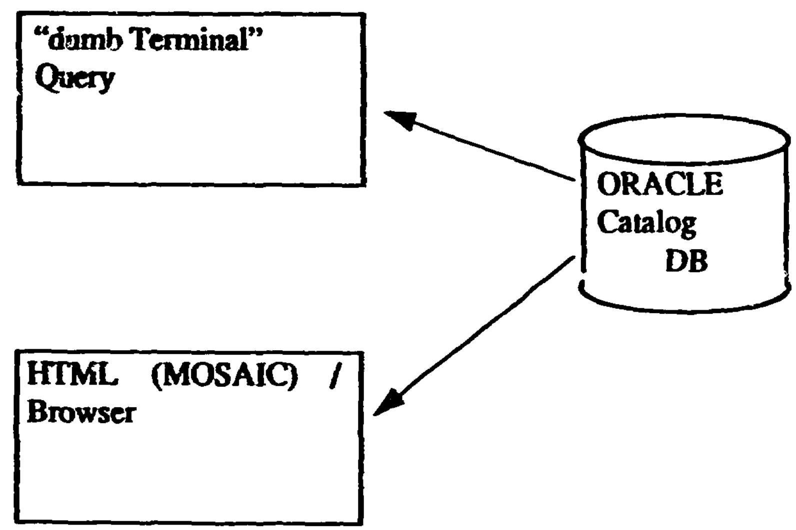
1. Choose /Define/Document SDF (Standard Data Format)
2. Implement 1, 2, and 3
3. Develop procedures for using the scenarios
4. Design paper "form" (more like an IRS long form)

IDA

Data Retrieval Capabilities

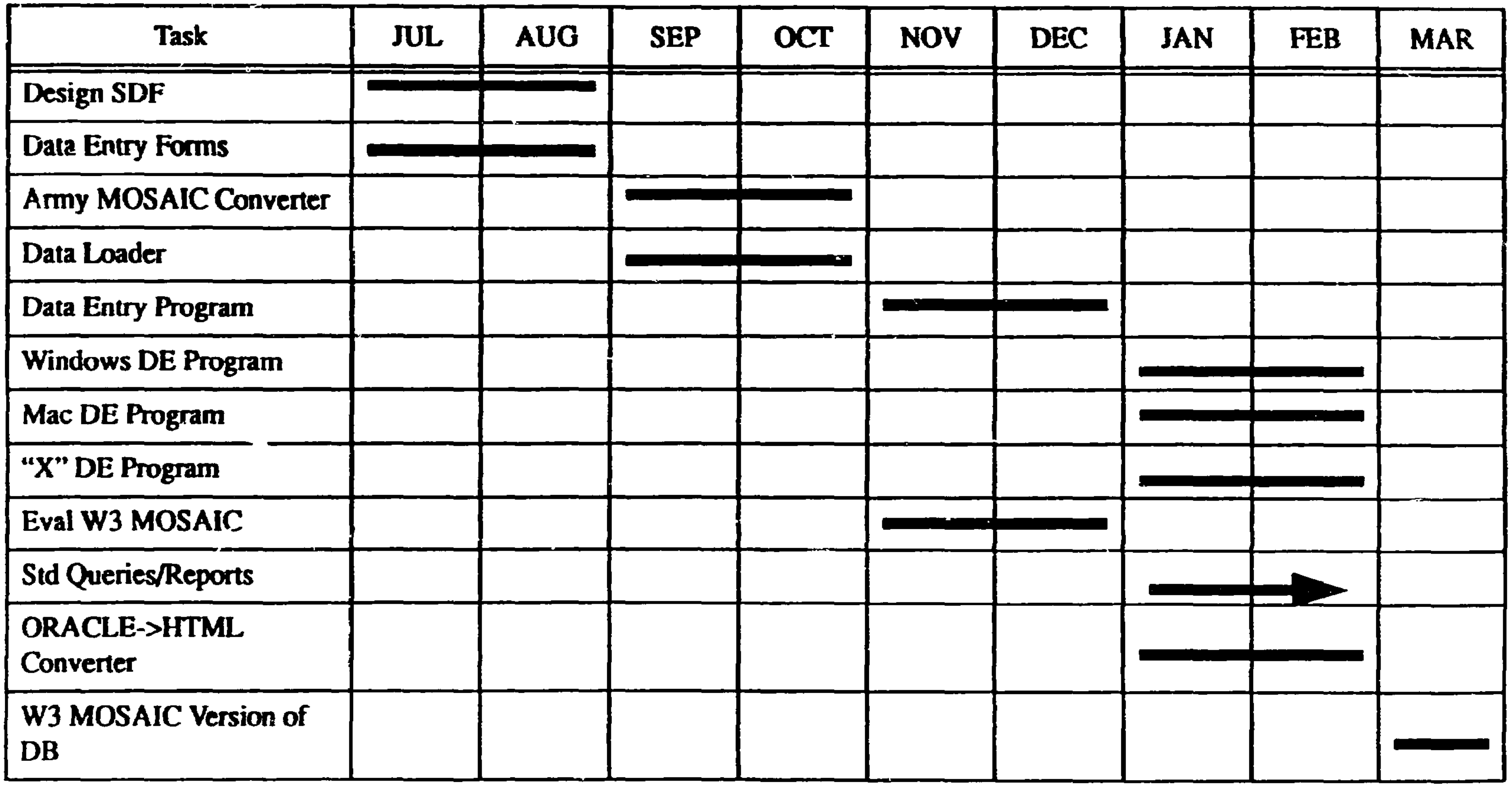
To be resolved

"standard set" of queries/reports



IDA

Schedule



IDA

SDF Requirements

- Program generated, but human readable (in fact, ASCII "printables")
- Support
  - source tracking
  - replace/append
  - repeating groups
  - large text fields

IDA

SDF Example

```
BDS:IDA:replace
MODEL:SimCity
MODEL_VERSION:Sim_City 2.0
END_MODEL_VERSION:
...
MODEL_VERSION:Sim_City 2.3
END_MODEL_VERSION:
...
EDS
```

IDA

INPUT_DATASET

Enter the information requested regarding the input dataset used with the model_version

The identifier to be used for this input dataset:

The date of this input dataset:

The name of this input dataset:

The version name of this input dataset:

Circle the security classification:

UNCLASSIFIED CONFIDENTIAL SECRET TOP SECRET

The release restriction of the input dataset:

The identifier of the input data used by this dataset:

The identifier of the database that this input dataset was built from:

This dataset is used as: (circle one and enter the identifier to the right of your choice)

DEVELOPMENT DATASET Identifier:

VALIDATION DATASET Identifier:

IDA

INPUT DATASET

Input Dataset Identifier: ____________________

Version Name: ____

Input Dataset Name: ____

Input Dataset Date: ______________________

Security Classification: __________ Release Restriction: ______________

Input Data Identifier: ____________________

Database Identifier: (that input dataset is built from): ____________________

Dataset is used as: (circle one and complete information to the right of choice)

DEVELOPMENT DATASET	Development Identifier: __________________
VALIDATION DATASET	Validation Identifier: __________________

IDA

(Howard Haeber) 8 M

Military Operations Research Society (MORS) Simulation Data and Its Management (SIMDATAM) Senior Advisory Group (SAG)

- Formed by MORS Executive Council (Michael F. Bauman, Chair)
  - ★ Mission: Guide future MORS activities in this subject area.
  - ★ Purpose: Provide guidance, answer questions to the MORS sponsors and be a sounding board on how the future SIMDATAM meetings should be conducted.
- 1st Meeting - 8 June

9 M

Department of Defense Information Management

Briefing for

MODELING AND SIMULATION INFORMATION/DATABASE TASK GROUP

July 11,1994

Bob Molter
703-604-1588

Data Administration

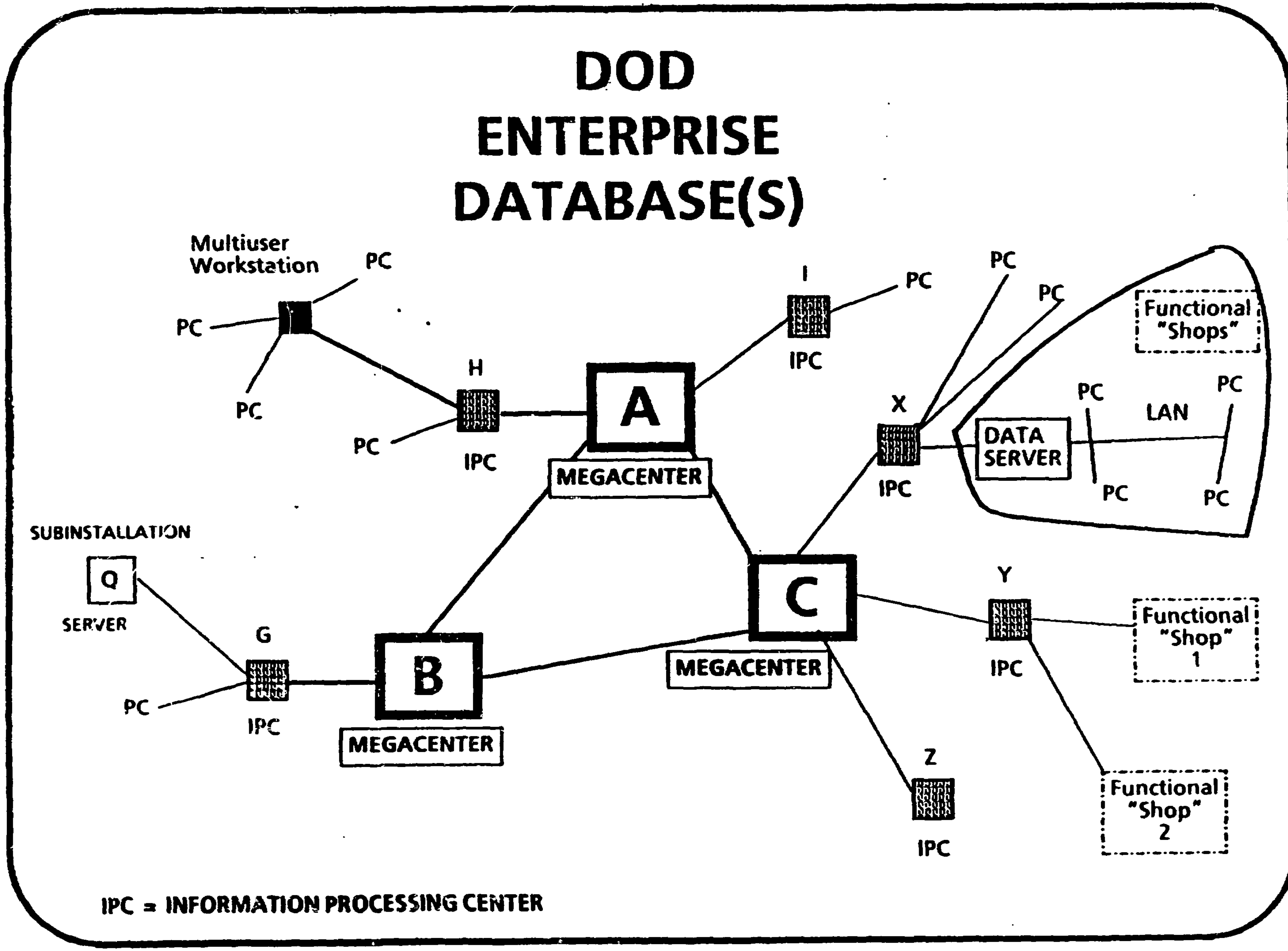
Implementation Status

- Policy (DoDD 8320.1) - Approved September 26, 1991
- Standards
  - Database language (FIPS 127-2) - Work moving on 3
  - IRDS (FIPS 156) - Work on -2 w/PCTE
  - Modeling (IDEF1X) - FIPS 184
- Infrastructure
  - People - Designated and in place
  - Megadata Centers - Being planned
- Procedures
  - Data Administration (DoD 8320.1-M) - Approved, March 1994
  - Data Element Standardization (DoD 8320.1-M-1) - Approved, January 1993
  - Data Modeling, Data Security, Data Quality Assurance, Database Administration - in draft

Data Administration

Implementation Status (Con't)

- Tools
  - Enterprise Model - published January, 1994 (includes both DoD Strategic Data and Process Models)
  - Central Repository - (DDRS) operational; populated with standard, developmental, and migration data
  - ICASE - awarded April 1994
- Data Administration Training
  - Class Presentations - Ongoing
  - Computer-based Training - Prepared
  - Data Administration Video - Available
- Miscellaneous
  - Data Administration Strategic Plan (DASP) - 2 published
  - FY94 Planning Guidance - Published
  - Data Migration Prototype - Reverse Engineering - Ongoing
  - Data Migration and Implementation Planning - Begun


DOD
ENTERPRISE
DATABASE(S)
Multiuser Workstation
PC
PC
PC
PC
H
IPC
A
MEGACENTER
I
IPC
PC
PC
PC
X
IPC
DATA SERVER
PC
PC
LAN
PC
PC
Functional "Shops"
SUBINSTALLATION
Q
SERVER
G
IPC
PC
B
MEGACENTER
C
MEGACENTER
Y
IPC
Functional "Shop" 1
Functional "Shop" 2
Z
IPC
IPC = INFORMATION PROCESSING CENTER

NIST

NATIONAL INSTITUTE OF STANDARDS AND TECHONOLGY

Bruce Rosen

Bruce K. Rosen
Manager, Data Admin. Group

Mailing Address:

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Gaithersburg, MD. 20899

Voice Phone: (301) 975-3246
FAX Phone: (301) 948-6213

EMAIL: brosen@nist.gov

REPOSITORY
DICTIONARY
DIRECTORY
ENCYCLOPEDIA

STANDARDS
TODAY

OR

WHO'S ON FIRST

WHAT'S ON SECOND

I DON'T KNOW'S
ON THIRD

THE SCORECARD

American National Standards Institute (ANSI) X3H4

- X3.138-1988, Information Resource Dictionary System (IRDS)
- X3.195-1991, IRDS Export/ Import File Format Specification
- X3.185-1992, IRDS Services Interface

International Organization for Standardization (ISO)

ISO/IEC JTC1 SC21 WG3
IRDS Rapporteur Group

- ISO IS10728(E), IRDS Services Interface
- ISO IS 10027(E), IRDS Framework

European Computer Manufacturers Association (ECMA)

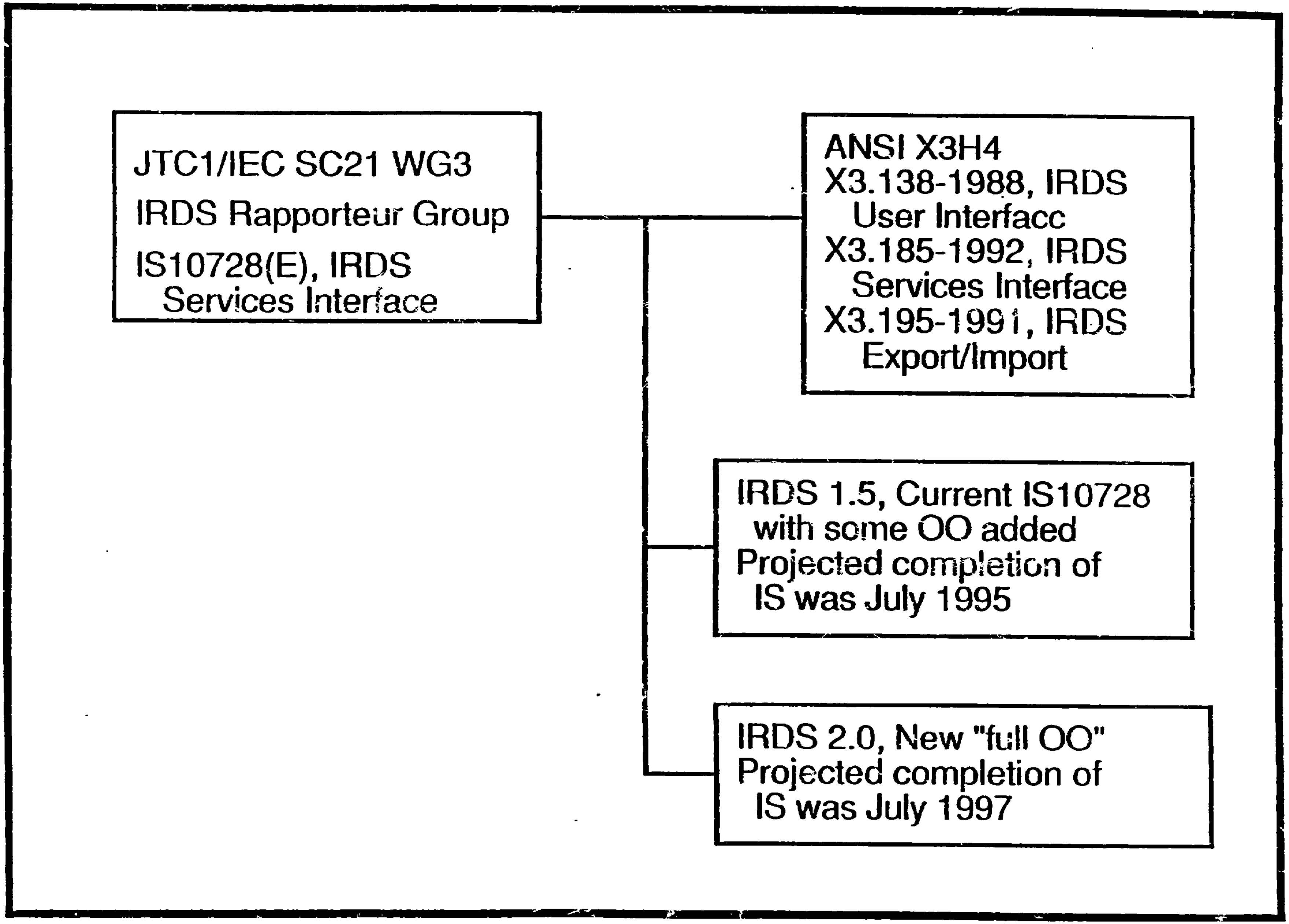
ECMA Technical Committee 33 (TC33)

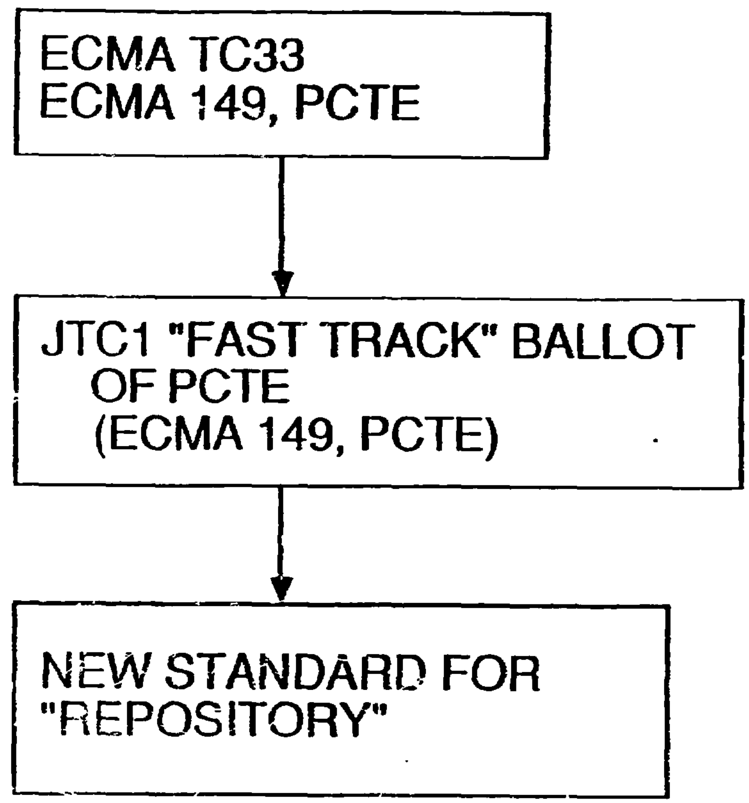
ECMA 149, Portable Common Tool Environment (PCTE)

Rookies:

ECMA TC33 Technical Group for Object Oriented (TGOO)

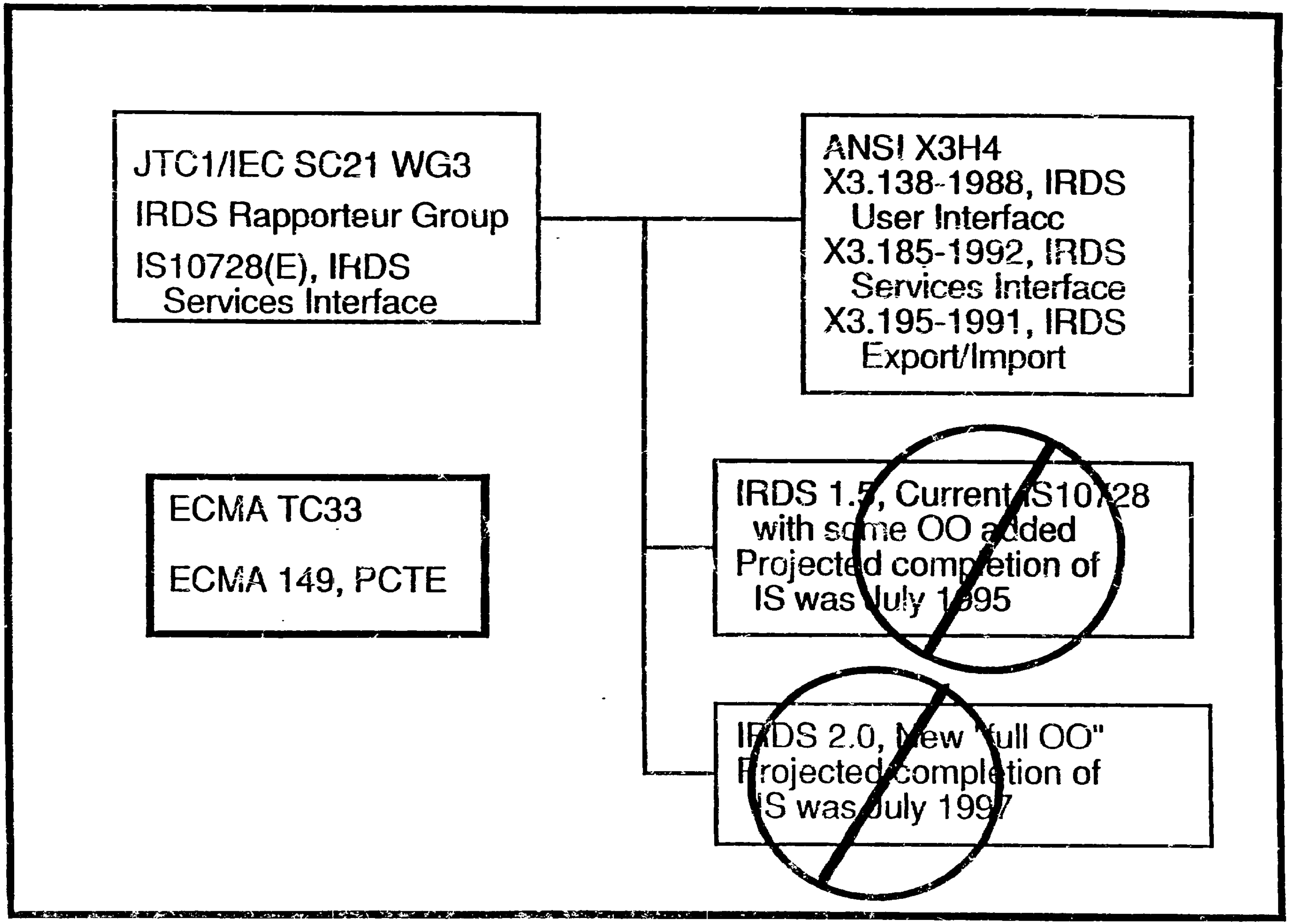
North American PCTE Initiative, now part of Object Management Group (OMG) and called Special Interest Group (SIG) PCTE


JTC1/IEC SC21 WG3
IRDS Rapporteur Group
IS10728(E), IRDS Services Interface
ANSI X3H4
X3.138-1988, IRDS User Interfacc
X3.185-1992, IRDS Services Interface
X3.195-1991, IRDS Export/Import
IRDS 1.5, Current IS10728 with some OO added
Projected completion of IS was July 1995
IRDS 2.0, New "full OO"
Projected completion of IS was July 1997



ECMA REQUESTED THAT THE STANDARD BE PLACED UNDER SC22

BALLOT RESULTS 20 FOR; 2 AGAINST; 2 ABSTAIN


JTC1/IEC SC21 WG3
IRDS Rapporteur Group
IS10728(E), IRDS
Services Interface
ANSI X3H4
X3.138-1988, IRDS
User Interfacc
X3.185-1992, IRDS
Services Interface
X3.195-1991, IRDS
Export/Import
ECMA TC33
ECMA 149, PCTE
IRDS 1.5, Current IS10728
with some OO added
Projected completion of
IS was July 1995
IRDS 2.0, New "full OO"
Projected completion of
IS was July 1997

X3H4 HAS NOW ASKED THE OMC TO TAKE THE FOLLOWING ACTIONS:

X3H4 be removed as TAG to ISO IRDS Rapporteur Group

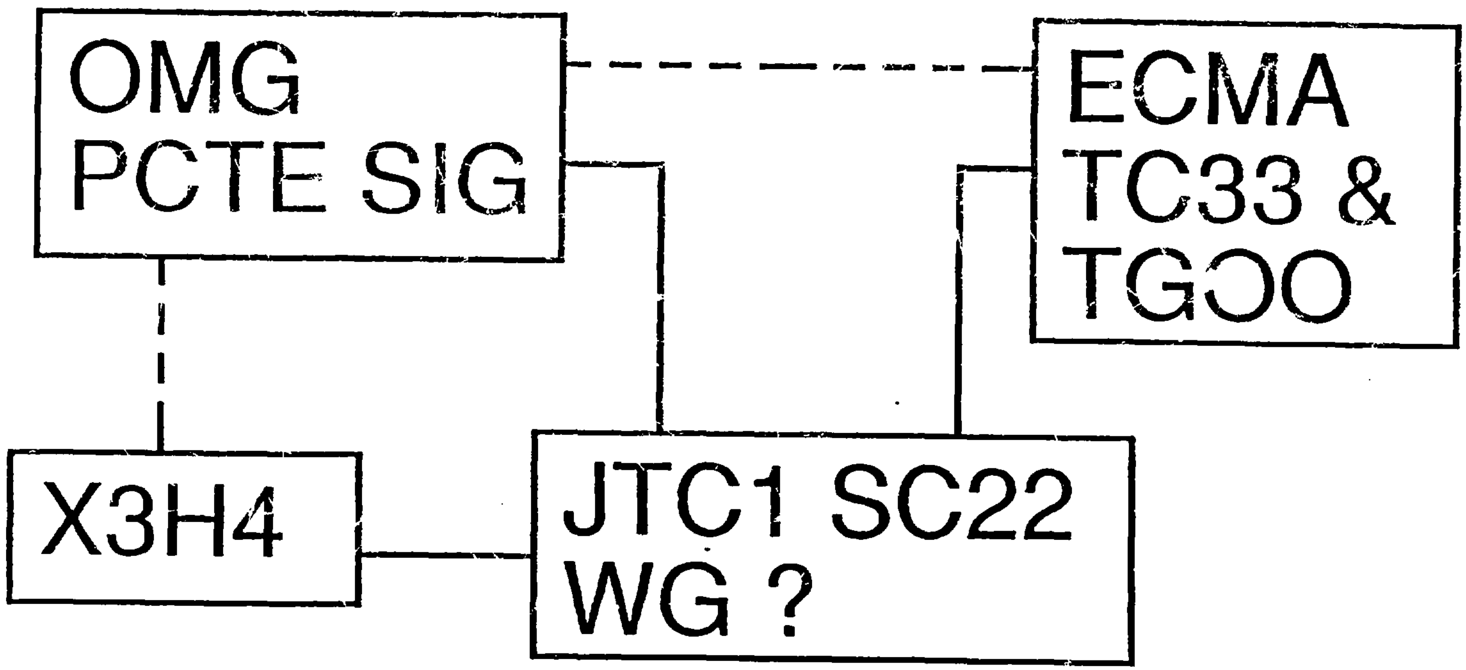
X3H4 be assigned as TAG to the new ISO group responsible for PCTE

X3H4 be renamed to whatever name is chosen for the new JTC1 group responsible for PCTE standardization

FUTURE

PREDICTIONS

POSSIBLE FUTURE "REPOSITORY STANDARDS GROUP" ALIGNMENT



PCTE becomes focus of REPOSITORY (both SW and DA oriented) standards development!!!!!!!

What this could mean is:

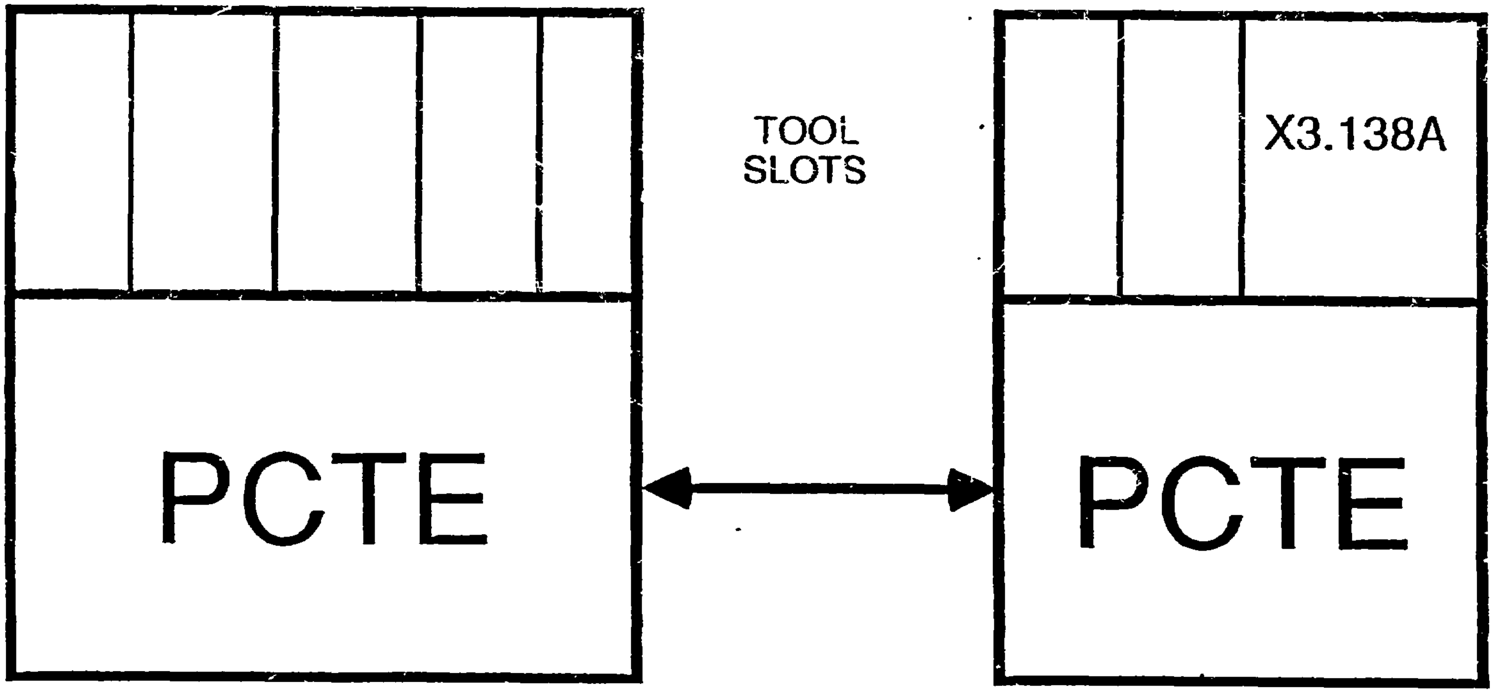
US IRDS (X3.138) would remain viable as a user interface standard

US IRDS Export/Import could remain viable

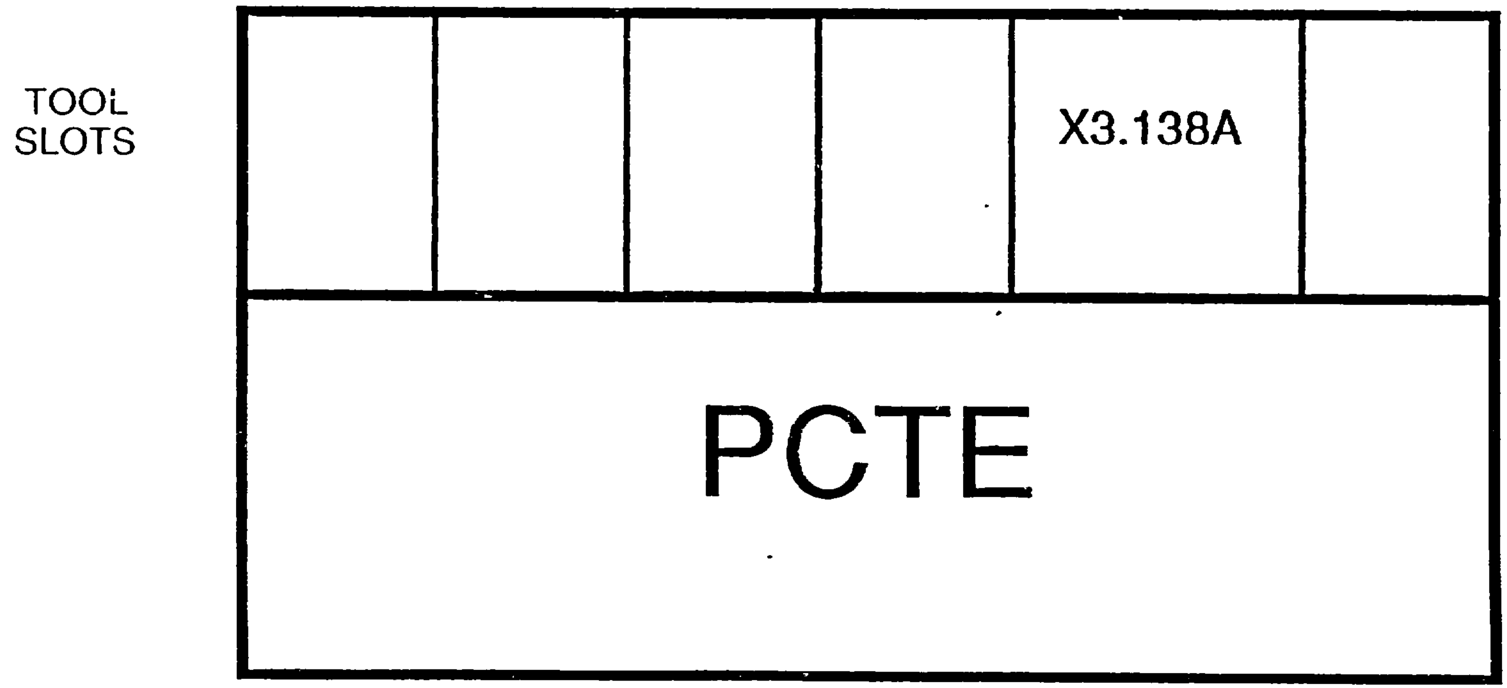
US IRDS Services Interface would be dropped

ISO IRDS (IS10728) would be dropped

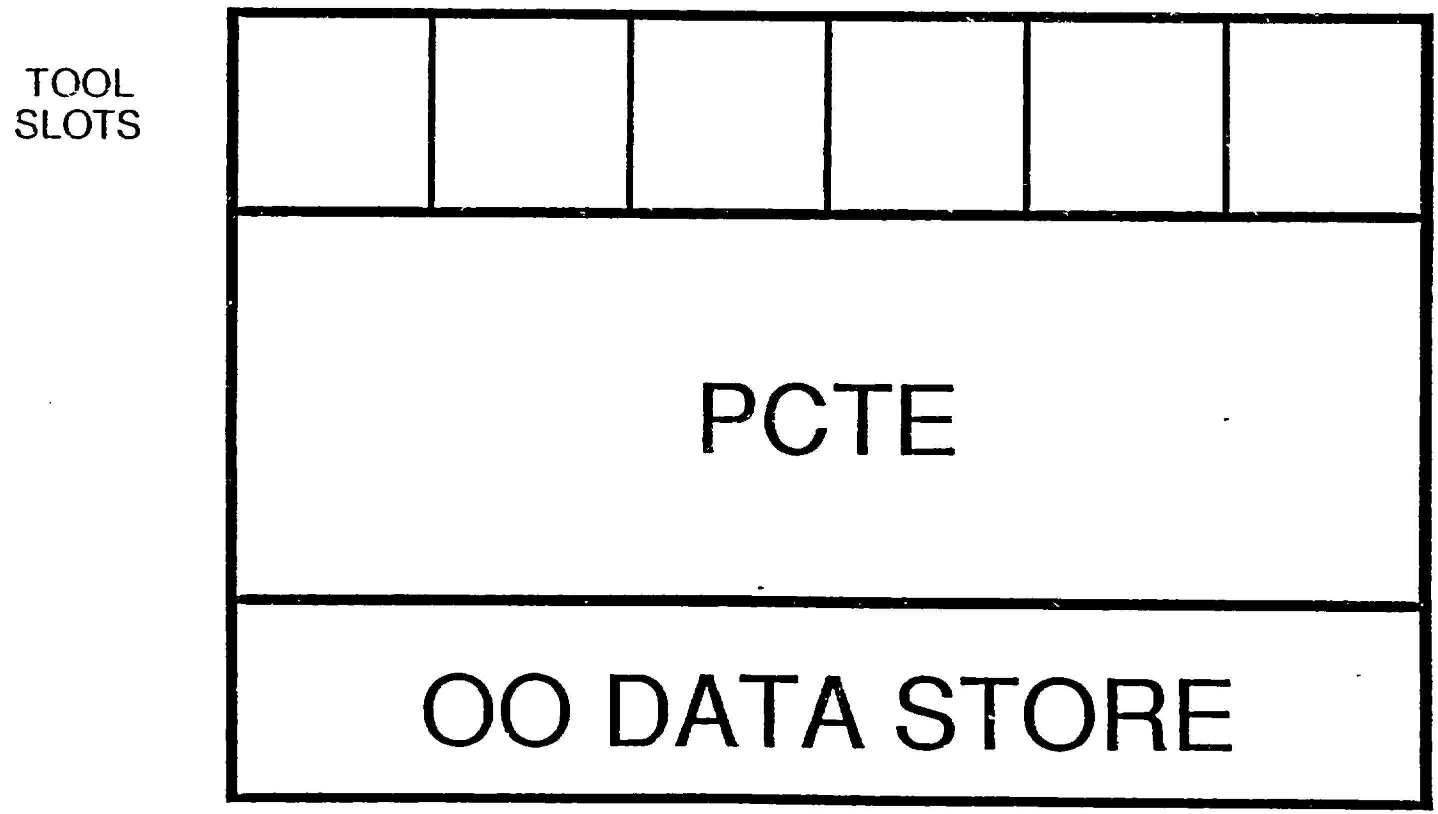
ALTERNATE POSSIBLE IMPLEMENTATION ARCHITECTURE OF ANSI IRDS AND PCTE



POSSIBLE IMPLEMENTATION ARCHITECTURE OF ANSI IRDS AND PCTE



FUTURE PCTE USING OTHER OO STANDARD



12A

OUSD(A&T)'s Data Administration Program (Overview)

Gary Hurd
OUSD(A&T)/API
11 July 1994

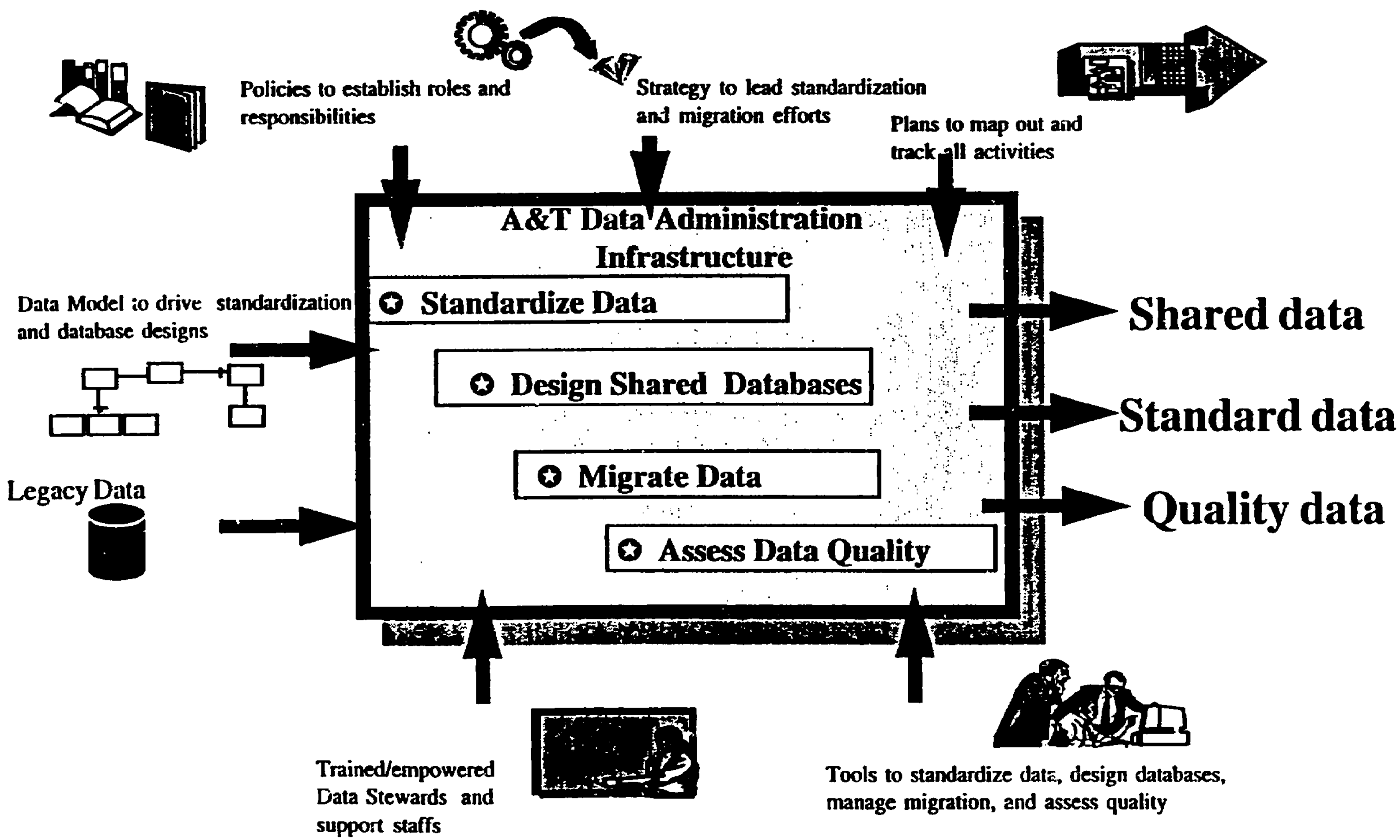
Data administration

- Establish data administration infrastructure
- Prepare integrated A&T Enterprise Data Administration Strategic Plan
- Coordinate data model development and data elements standardization
- Establish/empower A&T data stewards

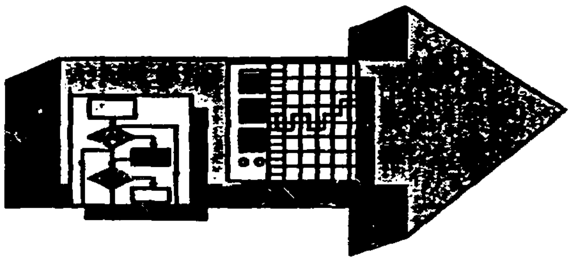
available

backup

Data administration infrastructure



Data Administration Strategic Plan



PURPOSE

- Specify objectives in support of DoD goals
- Coordinate activities among A&T community
- Basis for action plans

APPROACH

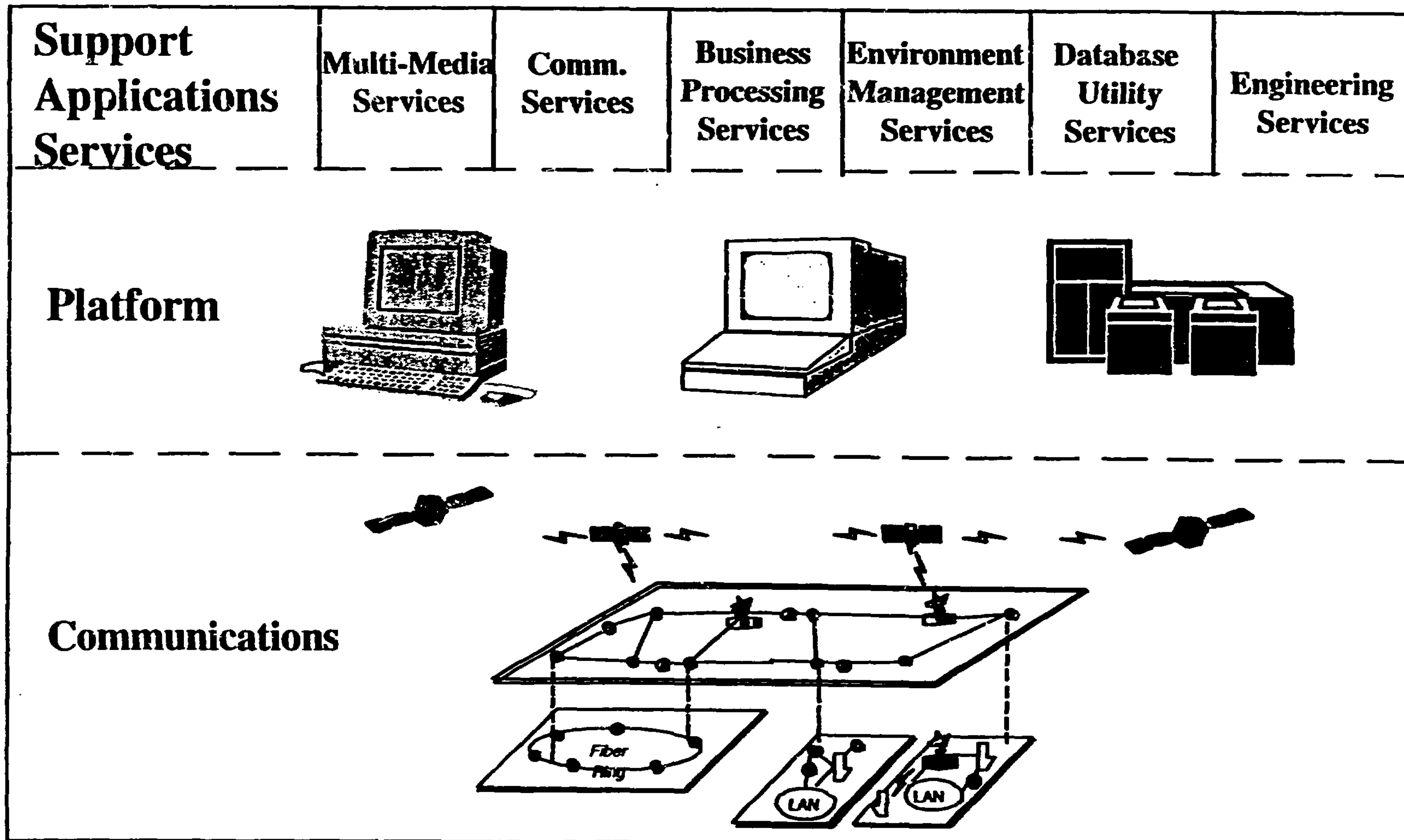
- Comply with Data Administration Program Management Office (DAPMO) guidelines
- Compile lessons learned
- Coordinate with process improvement
- Coordinate with Data Stewards

DELIVERABLES

✓FY93 DASP delivered 30 JUN 93

–FY94 DASP due 10 DEC 93

Information infrastructure definition



12 M

OUSD(A&T)'s CIM Program

Gary Hurd
OUSD(A&T)/API
11 July 1994

Overview

- DoD CIM Program
- A&T CIM Integration Program description
- Organizational Participation
- Components of the Program
- A&T Functional Areas
- A&T CIM Initiatives
- Expected Benefits

DoD's CIM Program

- A long term program whose primary emphasis is improvement in the way each functional area conducts its business throughout DoD
- Implements the CALS vision
- Principal Staff Assistants (PSAs) are personally responsible for their area
- DoD 8000 series of directives provide guidance for program

CIM: A DEPSECDEF PRIORITY

- **13 OCT 1993 DEPSECDEF PERRY'S MEMO**
  - Reaffirmed commitment to the CIM Program
  - Emphasized Migration System Selection, Data Standardization, in addition to Process Reengineering
- **6 APR 1994 DEPSECDEF DEUTCH'S MEMO**
  - Reaffirms emphasis of 13 Oct 93 memo and establishes:
    - » Enterprise Integration Executive Board
      - USD(A&T) as Executive secretary
    - » Enterprise Integration Corporate Management Council
      - Co-chaired by USD(A&T)
      - Membership includes DUSD(AR), DUSD(Log), DUSD(EnS)

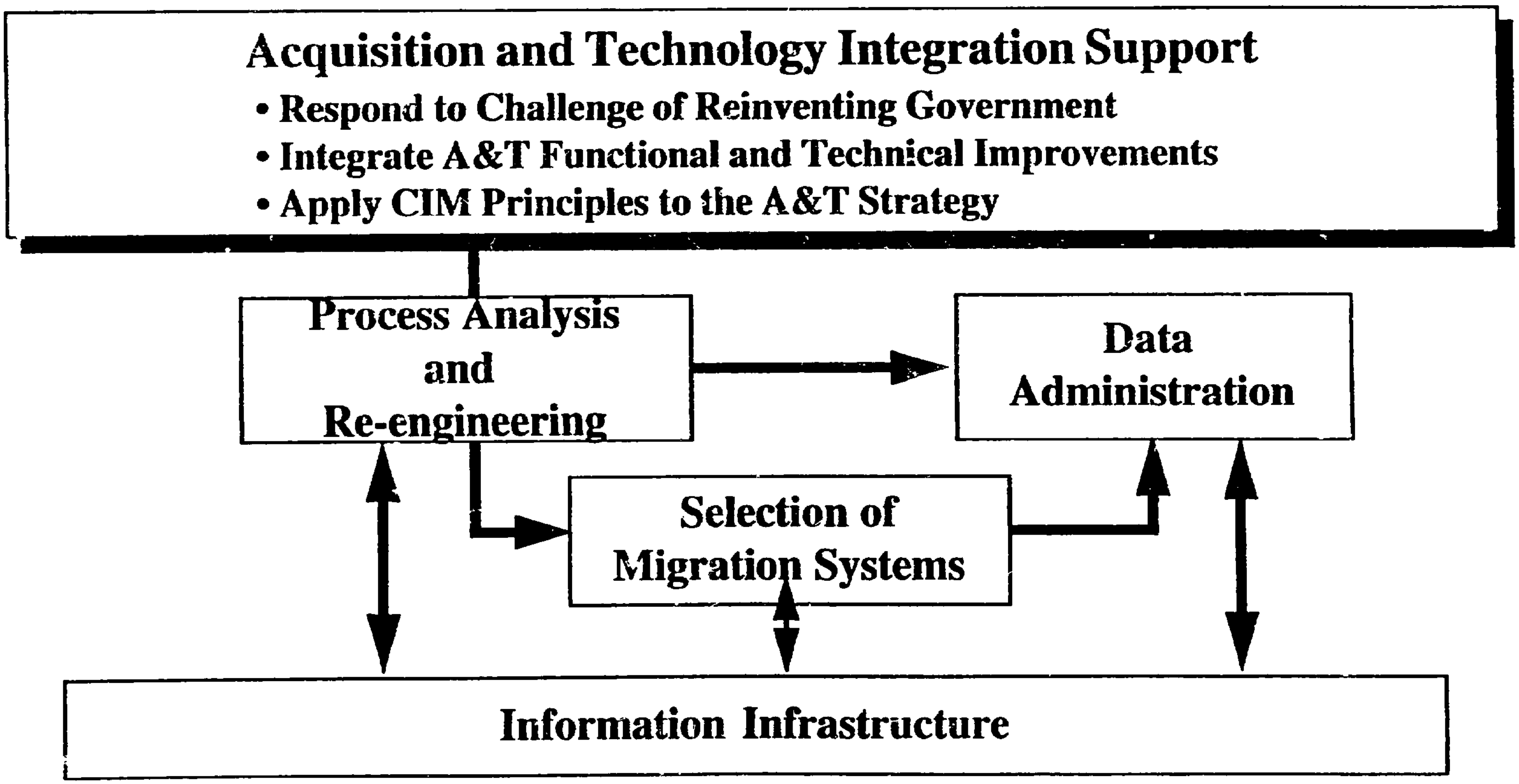
A&T CIM Integration (ACI) Program

- Instigated by C3I - Executed by ACI Office
- Mission: Facilitate integration of all A&T CIMs
  - With one another
  - With non-A&T CIM efforts
- Purpose
  - Define approach for improving and integrating acquisition policies, business processes, and supporting information systems
  - Assist DoD officials in Acquisition Reform, rightsizing, and improving acquisition processes
  - Achieve near-term (3 years or less) changes in how DoD operates

A&T CIM Program Organizational Participation

- Program responsibility resides with functionals
  - PSAs and principals responsible for own functional areas (e.g., compliance with the Perry memo rqmts)
- Each program is executed through functional stewards
  - Process steward: Functional area program manager (FAPM)
  - Data steward: Functional data administrator (FDAd)
- Program start up and integration activities are facilitated by ACI

Relationship among components



Functional CIM Offices in OUSD(A&T)

- Logistics
- Procurement
- Environmental Security
- Economic Security
- Systems Acquisition Management
- Science and Technology
- Test and Evaluation
- Atomic Energy

Present: FY93-FY94 CIM Initiatives

	FY93	Oct 94 Perry Memo	FY94

Functional Area Initiatives

- Logistics — [Systems Inventory & Selection; Implementation Plans]
- Procurement — [Systems Inventory & Selection; Implementation Plans]
- Environment — [Systems Inventory & Selection]
- New CIM Starts (5) [chartering, organizational structure, workshops]

<u>A&T Level</u>

Planning

- ATBIP
- Data Standardization Program
- Funding for New Starts
- CIM Director Meetings
- PSA Meetings

Integration

- FAPM/FDAd Program
- Established A&T Enterprise Models
- Integration Workshops
  - Environmental
  - Procurement
  - Logistics (pending)
- Establish Interface Issue Methodology
- Alignment with C3I/DISA Direction
  - common tools
  - methodologies
  - DII shared Infrastructure

Expected Benefits from CIM initiatives

- Improve definition and control of A&T processes
- Identify targets for performance improvements
- Basis for improved information systems
- Near-term reductions in information systems costs
- Near-term improvements in decision support systems information

For further information, contact:

- Gary Hurd
  OUSD(A&T)/API
  Room 1E461, Pentagon

- Phone: (703) 693-4594
- FAX: (703) 693-9442
- Email: ghurd@acq.osd.mil

13N

Command and Control (C2) Functional Data Administration Program

DISA JIEO Center for Standards

Stan Plummer
C3I Support Division
DISA JIEO CFS
(703) 487-3539

11 July 1994

C2 FDAd Mission

Achieve a fully interoperable C2 environment through effective data standards coordination and program development, including data elements and data models for C2 Projects, programs, and migration systems.

Use for Dis

C2 Functional Data Administrator (FDAd)

- Ms. Deborah Castleman
- Office of the Secretary of Defense,
  Deputy Assistant Secretary of Defense for
  Command, Control, and Communications (C3)

Authority

- DoD Directive 8000.1, "Information Management Program"
- DoD Directive 8320.1, "Department of Defense Data Administration"
- Command and Control Data Administration Strategic Plan, FYs 1994-2001

Goals

- Support Joint and Combined Operations
- Aggressively Implement C2 Data Administration
- Promote coordination, cooperation, and participation of Functional Areas and Components (C/S/A)

Functions

- Provide Standard Data Elements
- Maintain C2 Core Data Model
- Integrate C2 Subarea Data Models
- Coordinate with Functional and Component Data Administrators

Support to GCCS

- Principal C2 Migration System
- Vehicle for Accelerating Data Standardization
- Targeted Focus Sessions and Collaborative Modeling

C2 Data Administration Project Areas

- Data Modeling
- Data Elements
- Data Administration Policies and Procedures (document)

Data Modeling

- Process
  - Subarea models
  - Integrate with C2 Model
  - Propose Changes to DoD Model
- Efforts
  - C2 Core Data Model
  - Fire Support Model
  - Air Operations Model (FPI)
  - SOCOM Model (FPI)

Data Elements

- From the C2 Core Data Model
- C2 Input to Starter Set
- JUDI Data Elements

Program Policies and Procedures
(work in progress)

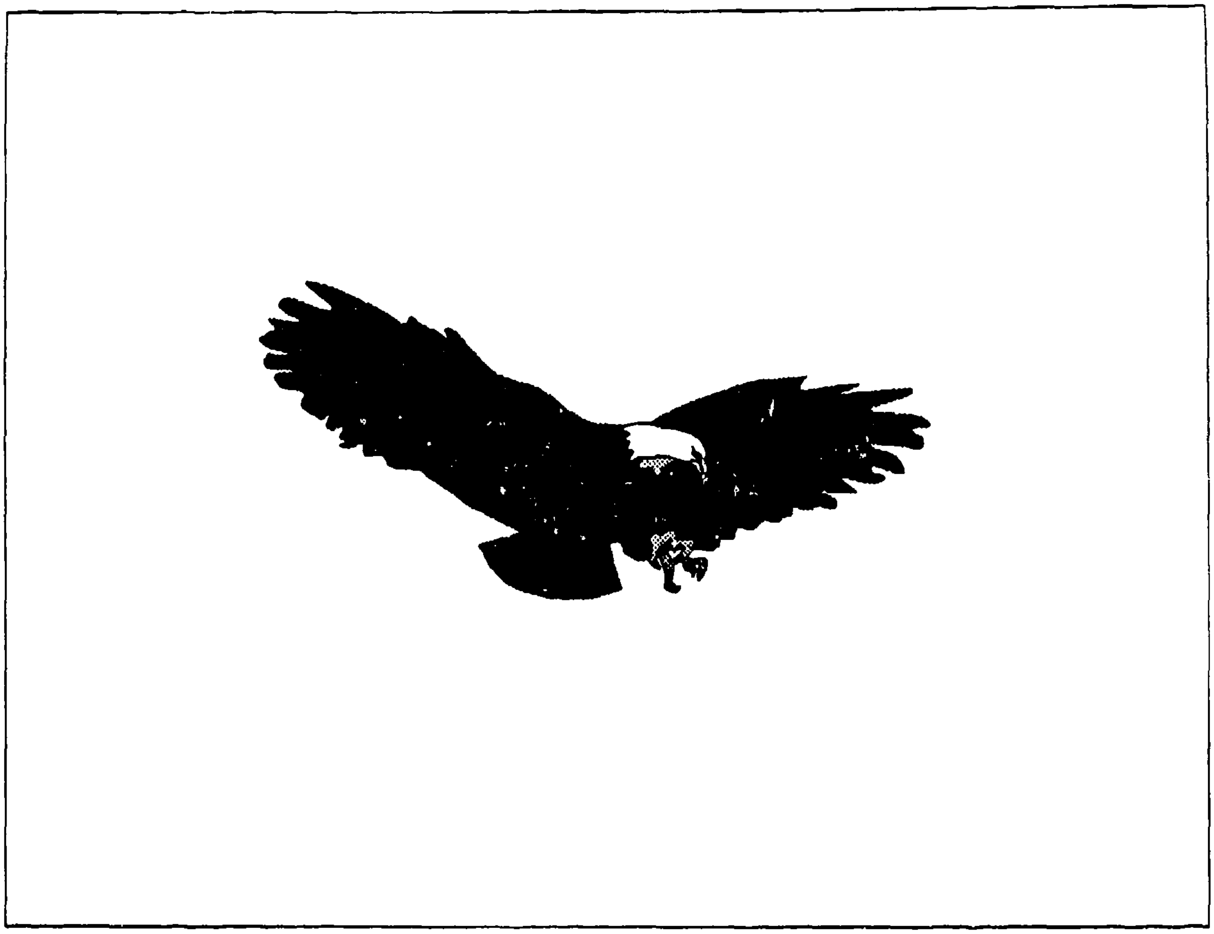
- Implement DoD Data Administration policy and direction
- Establish Procedures for C2 Data Administration
- Describe C2 Configuration Management (CM) Body
- Authorize publication of Configuration Management Procedures

C2 Core Data Model Status
(8 July 1994)

	Prime Words	Data Elements
Developmental	103	349
Candidate	31	189
DoD Standard	53	30

Summary

- Mission
- Goals
- Functions
- Projects
  - Data Modeling
  - Data Elements
  - Policy and Procedures
- Status



Data Administration Program Management Office

Carla von Bernewitz

Defense Information Systems Agency
Joint Interoperability and Engineering Organization
Center for Information Management
DOD Data Administration Program Management Office

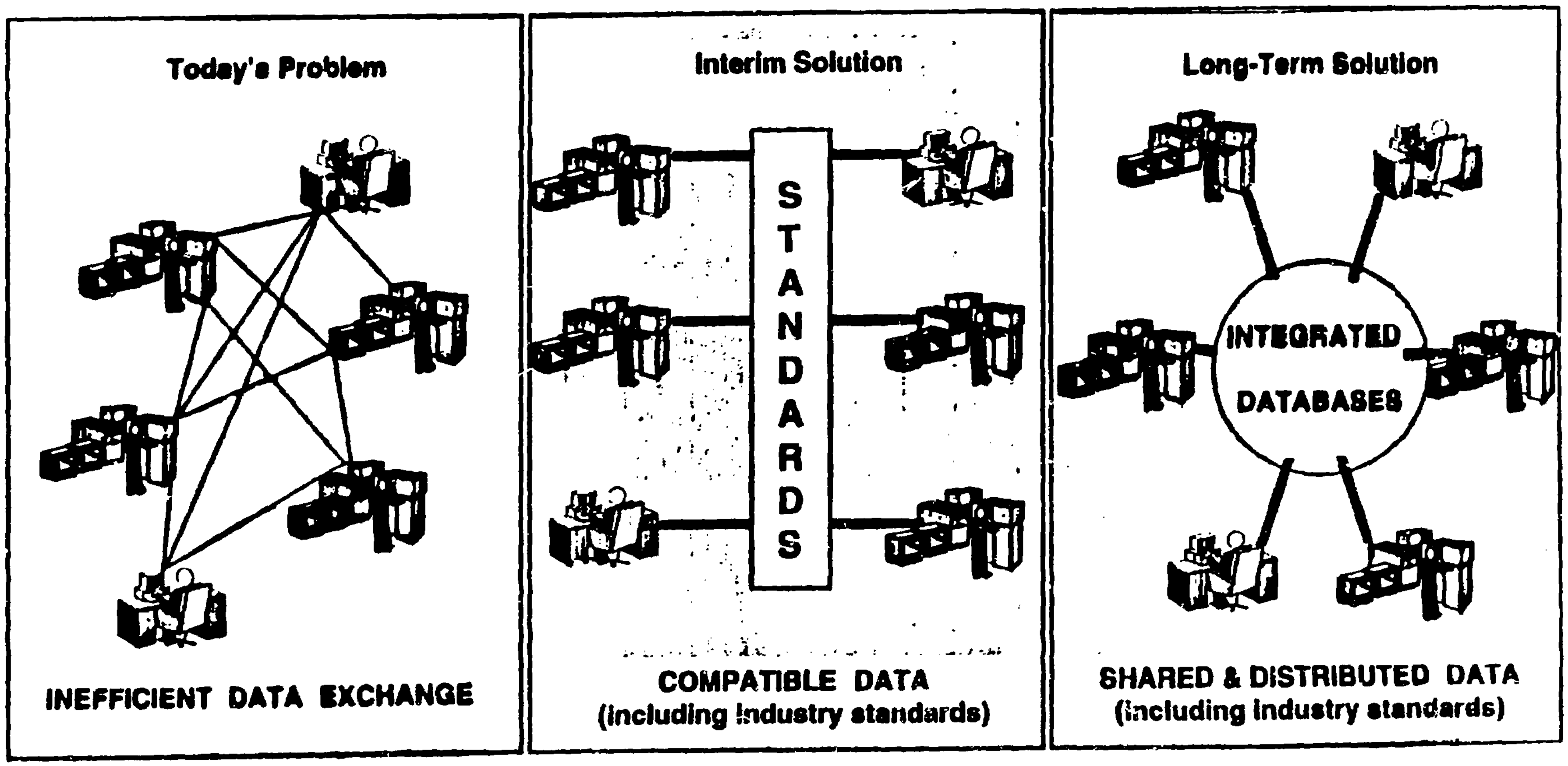
DATA ADMINISTRATION PROGRAM MANAGEMENT OFFICE

Mission: Define, plan, and organize the DOD Data Administration Program to promote definition, organization, operation, supervision, and protection of data within the DOD as a strategic resource.

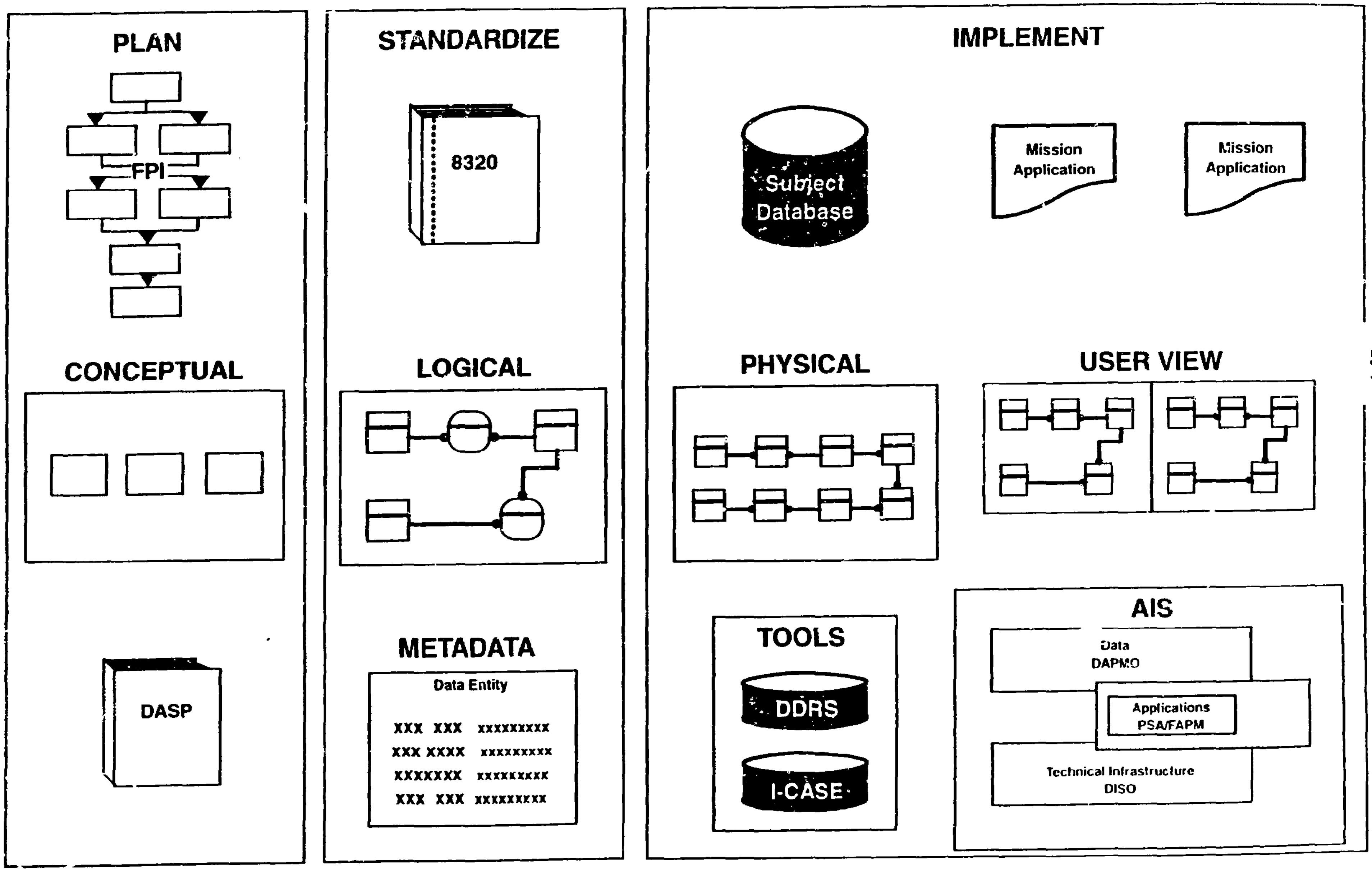
- Establishment of DOD Data Administration Program 26 Sep 91 (DODD 8320.1)
- Originally 8 year schedule for standard data
- Perry memo of 13 Oct 93 mandated a 3 year requirement for standard data

DATA ADMINISTRATION PROGRAM MANAGEMENT OFFICE

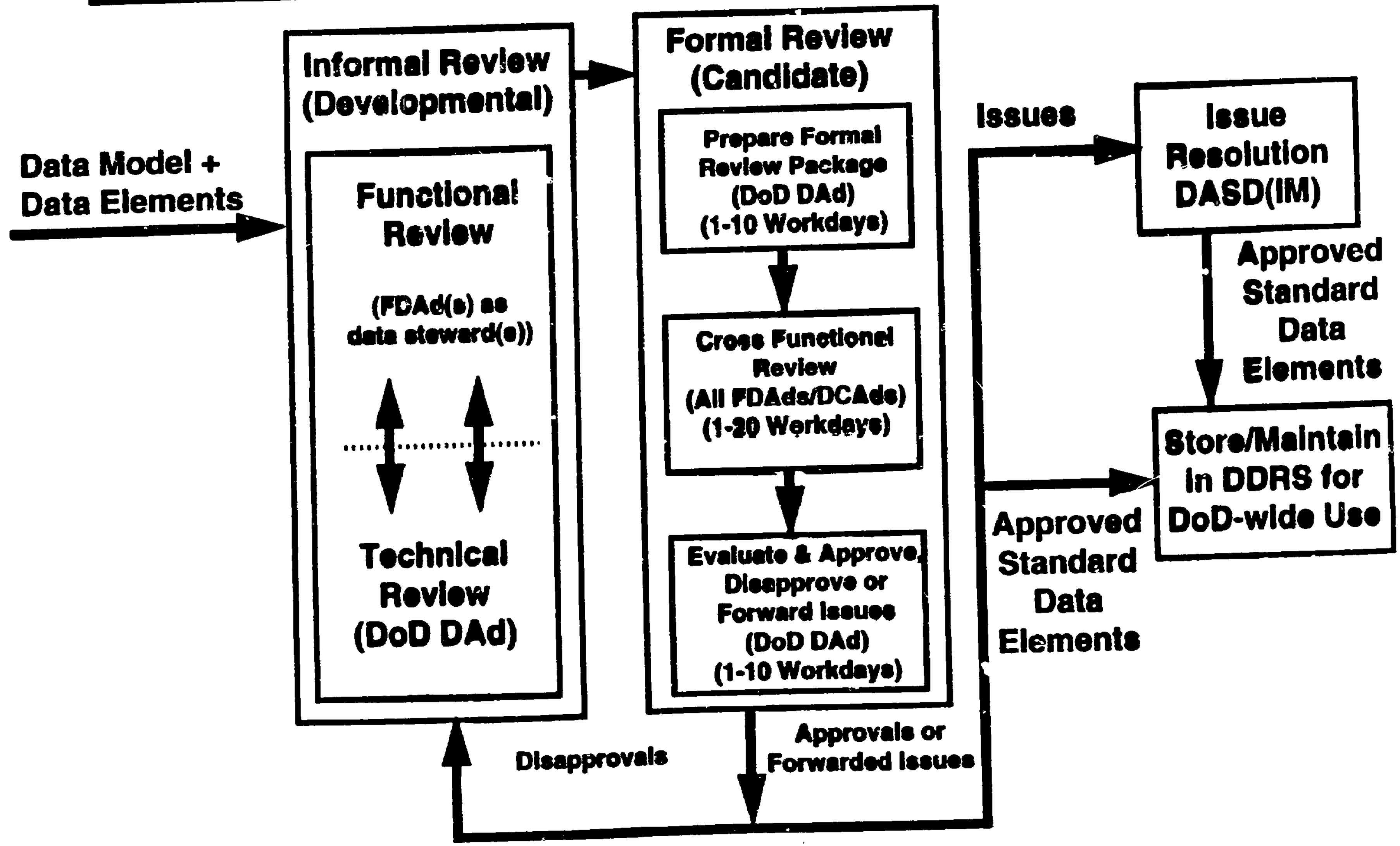
Interoperability Challenge



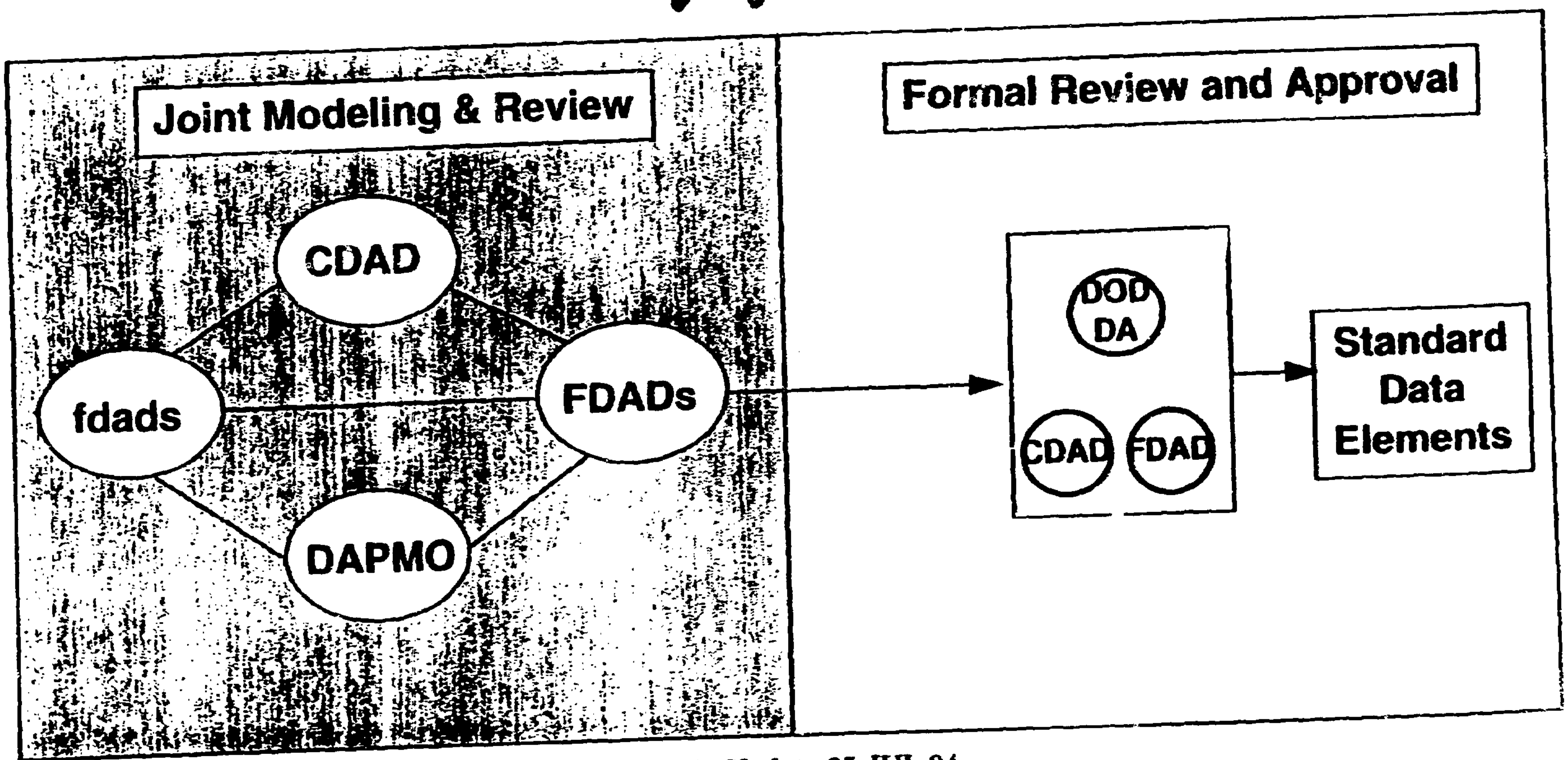
DATA AND THE SYSTEMS LIFECYCLE



GENERAL VIEW OF STANDARDIZATION REVIEW PROCESS



COLLABORATIVE MODELING



DISA\JIEO\CIM

MCEB Update 25 JUL 94

DATA STANDARDIZATION STATUS

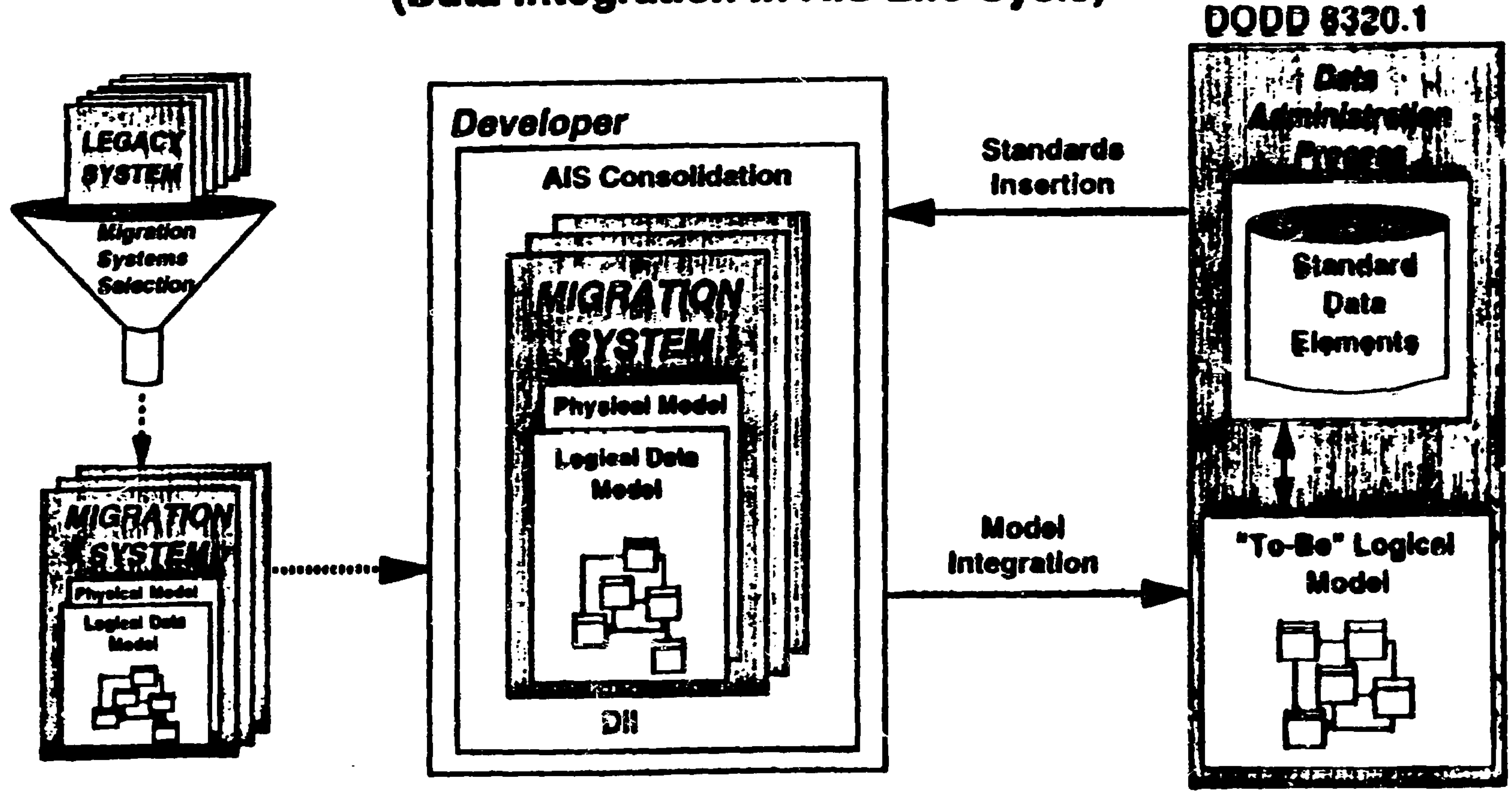
AS OF JULY 8, 1994

Approved Standard Data Elements (Attributes):	632
Approved Prime Words (Data Entities):	280

Candidate Standard Data Elements (Attributes):	304
Candidate Prime Words (Entities):	76

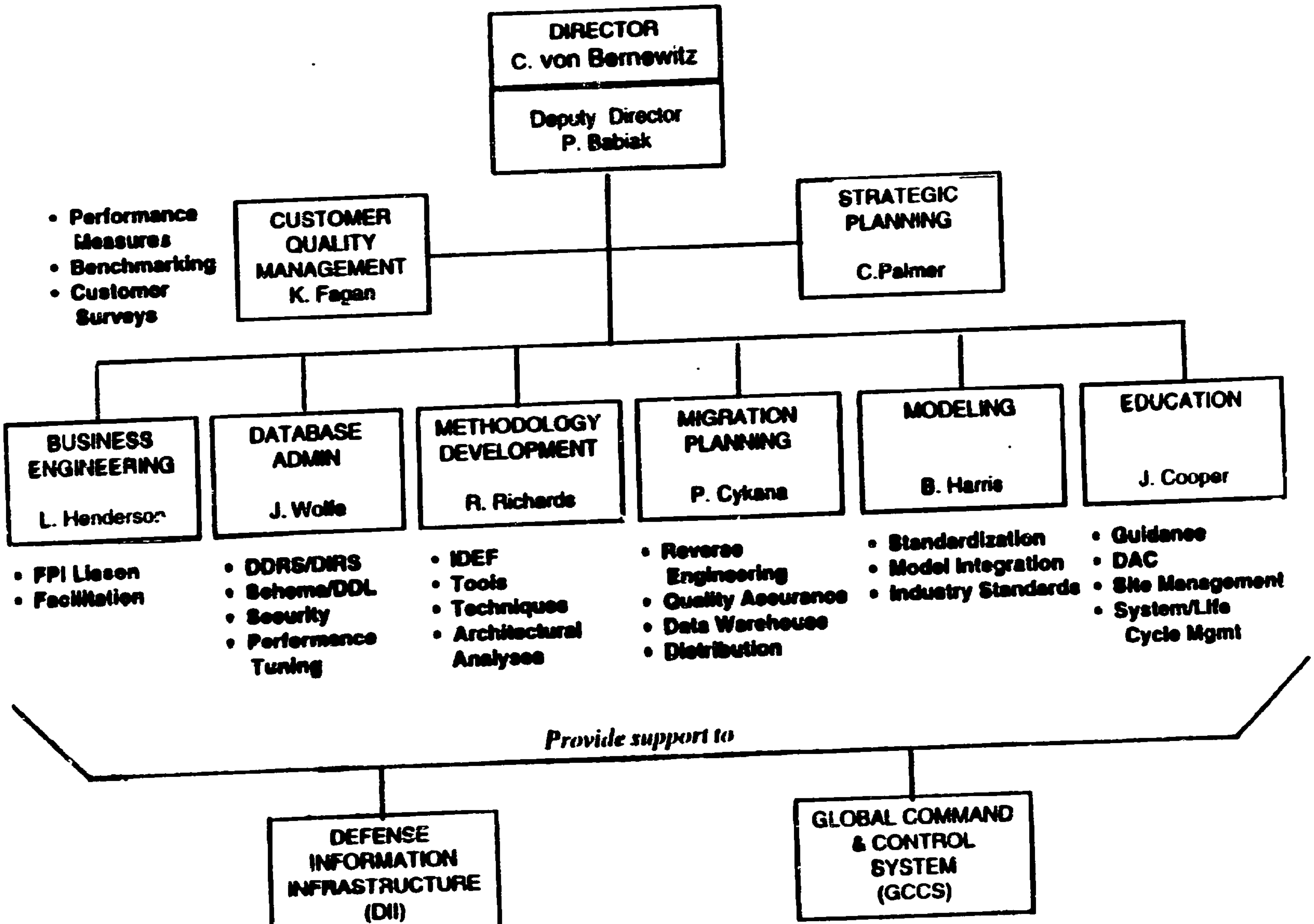
DATA ADMINISTRATION PROGRAM MANAGEMENT OFFICE

Migration Planning
(Data Integration in AIS Life Cycle)



DATA ADMINISTRATION PROGRAM MANAGEMENT OFFICE (DAPMO)

(DISA/JIEO/CIM/TXD)



As of 13 Jun 94

M/15

Data Element Specification and Standardization

Melody Rood
The MITRE Corporation
Software Engineering Center
(703) 883-6609
16 June 1994

MITRE

Purpose of the Briefing

To familiarize you with the emerging international ISO standard for data elements, ISO/IEC 11179, *Specification and Standardization of Data Elements*

MITRE

Agenda

- Highlight context
- Introduce relevant ISO and ANSI committees
- Introduce ISO/IEC 11179, Parts 1-6

MITRE

Context
Purpose of the Standard

- To enhance sharing of data (meaning/content) across systems by standardizing data element design

MITRE

Context: Problem

- Data elements are everywhere, but there is little guidance on how to design them
- Data elements are designed uniquely for each system or database and, therefore, not easy to share across systems
- A standard is needed for uniform data element design to enable data interchangeability

MITRE

Context: Utility of Standard

- Who?
  - Data managers
  - Data engineers
  - Data administrators
  - Software engineers and developers
  - Data dictionary developers
  - CASE tool developers

MITRE

Context: Utility of Standard - continued

- Why?
  - To share data, all data users and managers must have a common understanding of its
    - meaning
    - identification
    - representation

MITRE

Context:
Utility of Standard - concluded

- How? By
  - Standardizing the attributes of data elements (metadata) necessary to fully specify a data element's meaning, identification, and representation
  - Standardizing terminology

Standards Committees

- **ISO/IEC JTC1/SC14** ***Data Element Principles*** **(International Organization for Standardization/ International Electrotechnical Commission, Joint Technical Committee 1, Subcommittee 14)**

China	Netherlands
France	Sweden, Secretariat
Germany	U.K.
Japan	U.S.A.
Korea	

- **ANSI X3L8** ***Data Element Representation***

MITRE

Things to Know about 11179

- Does NOT standardize individual data elements
- Is methodology independent
- Standard is application-independent
- Developed with international/multilingual users in mind
- Users/testers
  - Bellcore, U.S.A.
  - Environmental Protection Agency (EPA), U.S.A.
  - Phillips International, Netherlands
  - ISO Basic Semantic Repository (BSR), Geneva, Switzerland

MITRE

Outline of Standard

- ISO/IEC 11179, *Data Element Specification and Standardization*, Parts 1-6
  - Part 1, Framework for the Specification and Standardization of Data Elements
  - Part 2, Classification of Concepts for the Identification of Domains
  - Part 3, Basic Attributes of Data Elements
  - Part 4, Rules and Guidelines for the Formulation of Data Definitions
  - Part 5, Naming and Identification Principles for Data Elements
  - Part 6, Registration of Data Elements

MITRE

Part 1, Framework

Framework for the Specification and Standardization of Data Elements

<u>Status</u>: Working group draft; v. 5 due 94-8-1

- **Introduces and relates Parts 2-6**
- **Discusses fundamental data element notions**
- **Contains complete glossary**

MITRE

Fundamental Data Element Notions

- data element
- metadata
- data dictionaries/repositories
- taxonomies/ontologies
- context terms and property terms
- value space/value domain
- domain predicate
- identification
- definition
- thesaurus
- registration authority

MITRE

Part 2, Classification

Classification of Concepts for the Identification of Domains

Status: Working group draft; v. 3 due 94-8-1

- Classification schema for property terms (i.e., class words), e.g:

  name date code

- Standardized identification and definition of property terms (class words) with their associated domains
- Classification schema for basic concepts
- Standardized identification and definition of basic concepts

MITRE

Part 3, Attributes

Basic Attributes of Data Elements

<u>Status</u>: Draft International Standard (DIS), currently being registered as an International Standard (IS)

- **Identifies and defines basic, application-independent attributes for specifying data elements**
- **Identifies mandatory (m), optional (o), and conditional (c) attributes for data elements**

Kinds of Attributes

- Five kinds of attributes
  - *identifying*, e.g:
    - name (m)
    - identifier (c)
    - version (c)
    - synonymous name (o)
  - *definitional*
    - definition (m)
    - permissible instances (m
  - *relational*
    - keyword(s) (o)
    - related element(s) (o)
  - *representational*
    - datatype (m)
    - form of representation (m)
  - *administrative*
    - responsible organization (o)
    - registration status (m)

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Part 4, Definitions

Rules and Guidelines for the Formulation of Data Definitions

Status: DIS, under ballot to be approved as an IS (July 17)

- **Definition is a mandatory attribute**
- **Provides guidance on creating a well-formulated definition**
- **Part 4 does not specify *format* of definitions**
- **Rules are testable, guidelines are determined by subjective criteria**

Rules

- A data definition shall:
  - a) be unique (within any data dictionary in which it appears)
  - b) be stated in the singular
  - c) state what the concept is, not only what it is not
  - d) be stated as a descriptive phrase or sentence
  - e) contain only commonly understood abbreviations
  - f) be expressed without embedding definitions of other data elements

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Guidelines

- A data definition should:
  - a) state the essential meaning of the concept
  - b) be precise and unambiguous
  - c) be concise
  - d) be able to stand alone
  - e) be expressed without embedding rationale, functional usage, domain information, or procedural information
  - f) avoid circular reasoning
  - g) use the same terminology and consistent logical structure for related definitions

MITRE

Part 5, Naming/Identification

Naming and Identification Principles for Data Elements

<u>Status</u>: Committee Draft (CD); under ballot to be released as DIS

- **A unique nonintelligent identifier must be assigned to each data element**

Part 5, Naming/Identification - concluded

- One or more names (alias) can be assigned to each data element for human understanding
- Name uniqueness is up to implementor
- No naming convention is prescribed

Kinds of Identification

- Identification of data elements can consist of
  - nonintelligent identifiers (tags)
  - names
  - icons

Note:

- Names are more suitable than most nonintelligent identifiers for use by humans, but cannot serve as the unique identifier

Part 6, Registration

Registration of Data Elements

<u>Status</u>: Working group draft; v. 2 due 94-8-1

- Provides guidance on how to register a data element in general within an organization and
- How to register a data element with the international Registration Authority (when established) for international standardization

MITRE

Levels of Registration

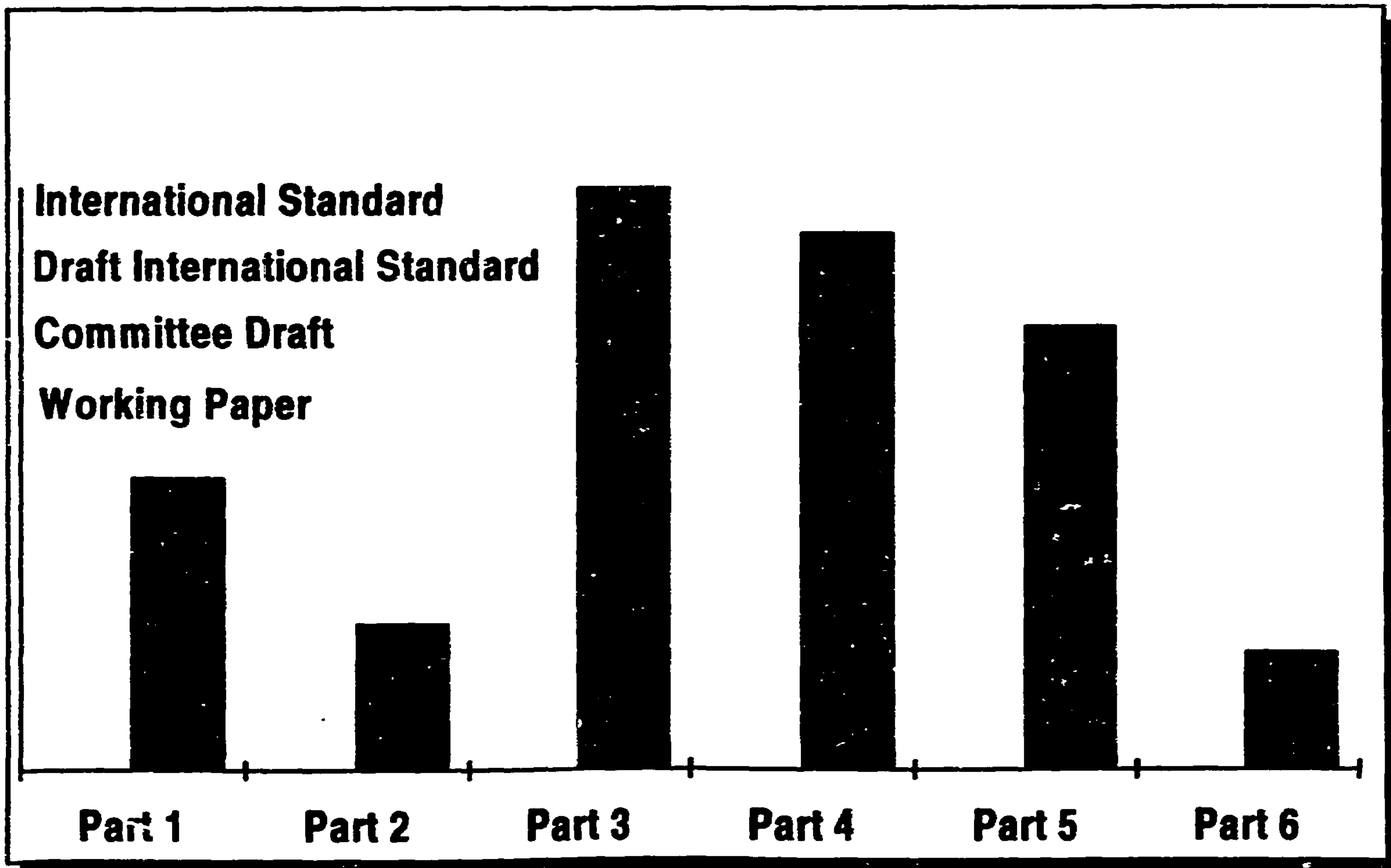
- International
- National
- Enterprise-wide
- Application-level

Summary

- Overview of emerging standard, ISO/IEC 11179
- Details available in documents comprising Parts 1-6 of the standard
- Input/comments to standard are welcome via ANSI X3L8
- Status of development

MITRE

Status of Parts



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Context/Definition: What is a Data Element?

- *Data* is a representation of facts, concepts, or instructions
- *Data* is collected, organized, recorded, processed, and stored
- *Data Element* is a single unit of data that in a certain context is considered indivisible

MITRE

Context/Definition: What is a Data Element? - continued

- *Data Element* is the least common denominator - the smallest constituent part that is shared and held in common among:
  - Information models
  - logical data models
  - data flow diagrams
  - data composites
  - contract specifications
  - computer programs

Context/Definition: What is a Data Element? - concluded

- Data element =
  - *field* in relational database tables
  - *attribute* of entity type in ERD
  - *attribute* in logical data model
  - *attribute* of object class in object model

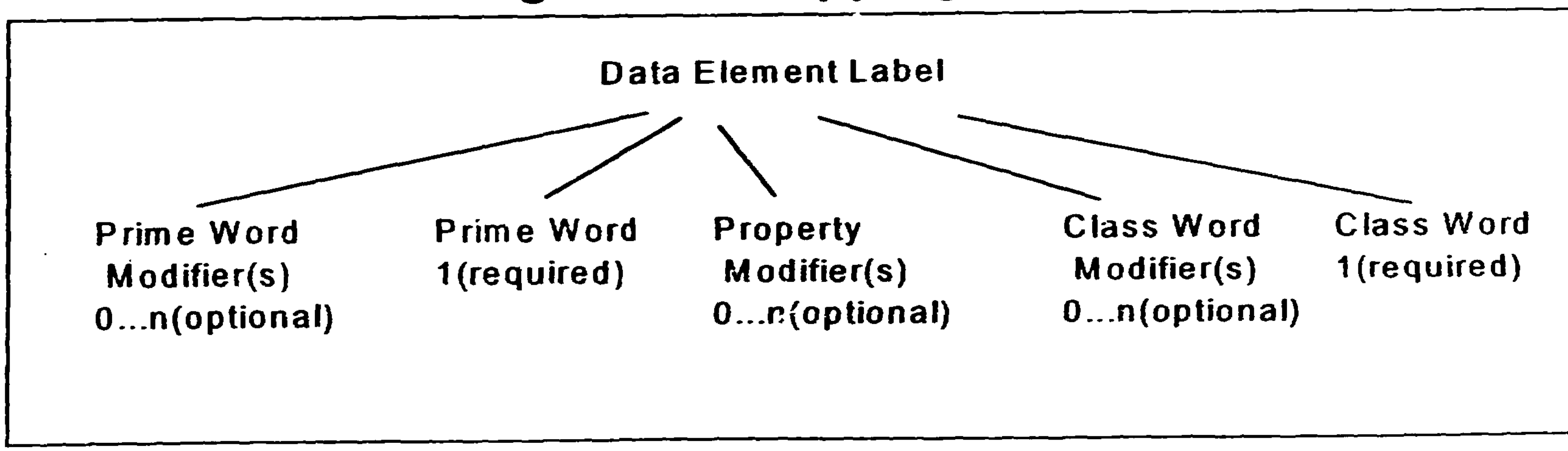
External Data Standards and DoD Data Administration

- Purpose
- Approach
- Expected Results

Phil CyKana

Purpose

- 8320.1 Series Guidance
  - National
  - International
  - Federal Standards
- Data Modeling, Data Mapping, Data Classification



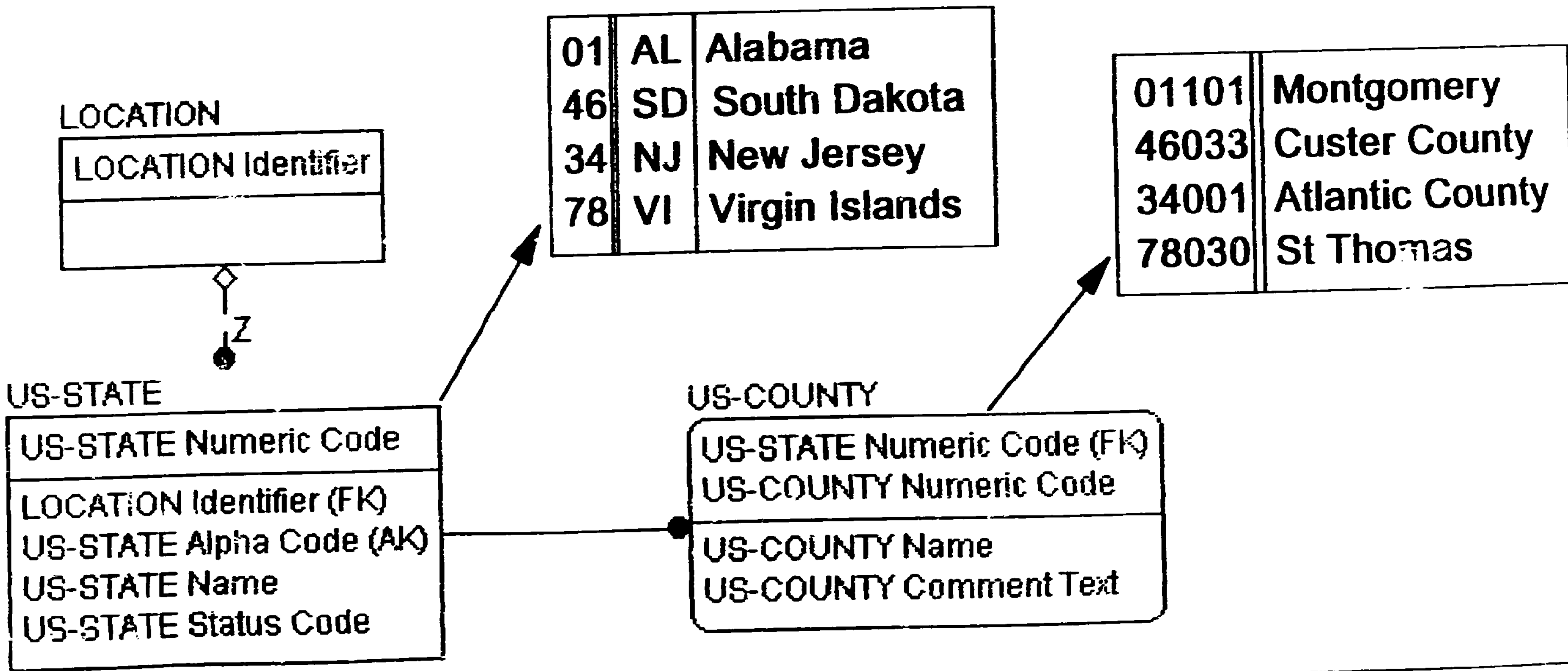
✓ Accelerate Development/Establishment of DoD Data Standards

Approach

Federal Information Process Standards (FIPS)

➤ FIPS PUB 5-2: Codes for the Identification of the states, the District of Columbia and the outlying areas of the United States, and asociated areas.

➤ FIPS PUB 6-4: Counties and Equivalent Entities of the U.S. Its Possessions, and Associated Areas Category: Federal General Data Standard Representations and Codes



Approach

External Data Standards:
ANSI X.12 Terms & Definitions

TRANSACTION SET:

850-Purchase Order
860-Purchase Order Change
840-Request of Quotation
862-Shipping Schedule

DATA SEGMENT:

PID-Product/Item Description (840, 850, 860,...)
P03-Additional Item Detail (840, 850, 860,...)
P01-Purchase Order Baseline Item Data (840, 850,...)
P04-Item Physical Details (840, 850, 860, 862...)

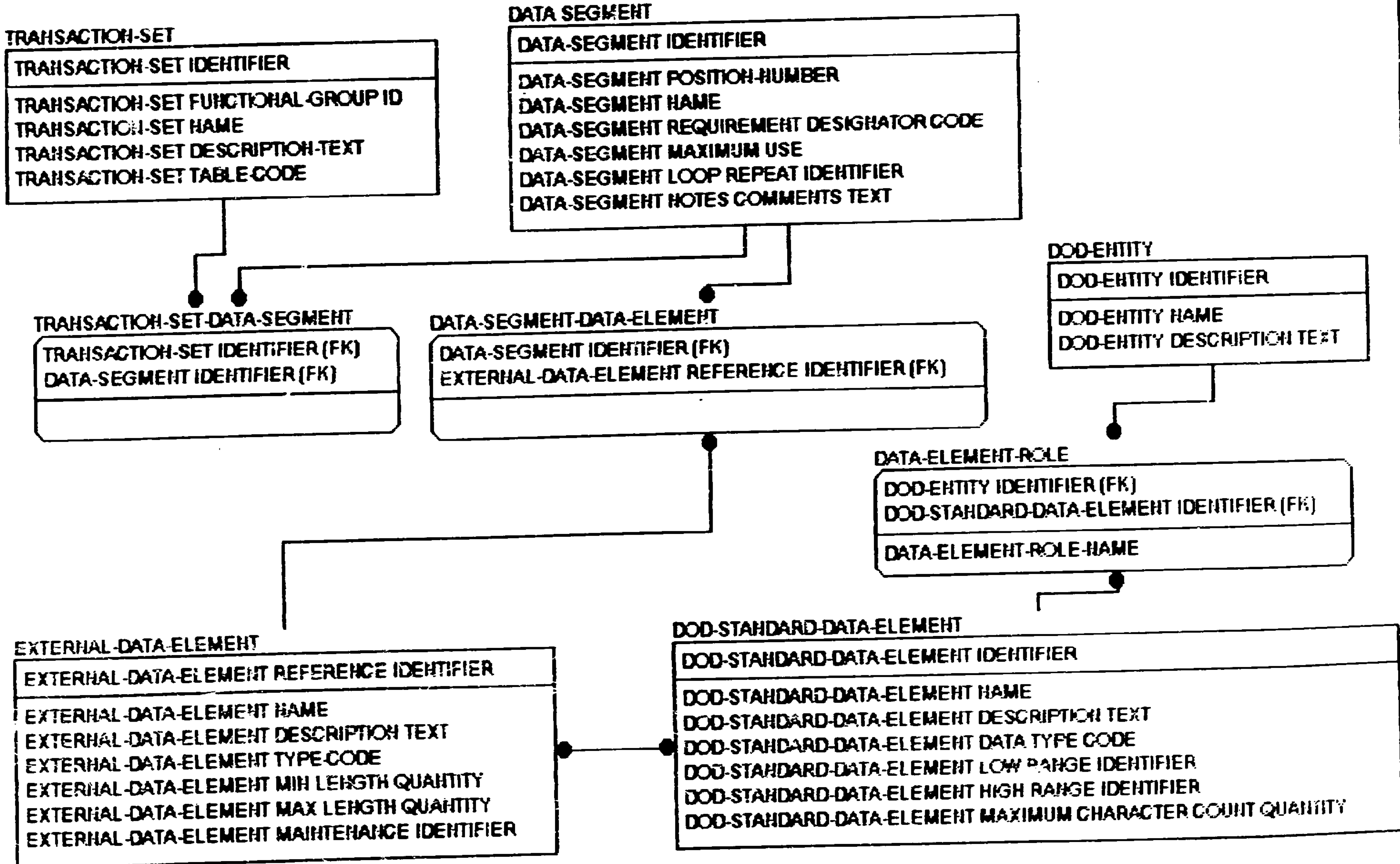
DATA ELEMENT:

352-Description (PID, PO3,...)
212-Unit Price (P01, PO3, POC...)
65-Height (PO4...)
330-Quantity Ordered (PO1, POC,...)
355-Unit of Measure Code (PO1, PO3, PO4...)
384-Width (PO4...)

PO3: Additional Item Detail

Change Reason Code	Date	Price Qual. Code	Unit Price	Basis Unit Price Code	Quantity	Unit of Measure Code	Description

Approach
External Standards: Metamodel



Approach

External Standards: Data Mapping

??

EXTERNAL DATA ELEMENT	POTENTIAL EQUIVALENTS AS DOD STANDARD DATA ELEMENT
352-Description	Materiel-Item Purchase Description Text
330-Quantity Ordered	Materiel-Item Purchase Order Duein Quantity
212-Unit Price	Materiel-Item Unit Price Amount
355-Unit of Measure Code	Materiel-Item Unit of Measure Code
65-Height	Materiel-Item Unit Height Dimension
384-Width	Materiel-Item Unit Width Dimension

Expected Results

- 1500+ Data Standards
- FDAd/CDAd Participation
  - Selection of Candidates
  - Data Model Review/Validation
  - Data Mapping Review/Validation
- Acceleration and Use of DoD Data Standards

EDHS
The ECS Data Handling System White Papers and Technical Papers

- The EDHS is the on-line distribution and storage system for documents about the EOSDIS Core System (ECS).
  - It is maintained by the Data Management Organization of Hughes Applied Information Systems (HAIS) at the ECS Development Facility (EDF).
  - http://edhs1.gsfc.nasa.gov

Patricia Liccett

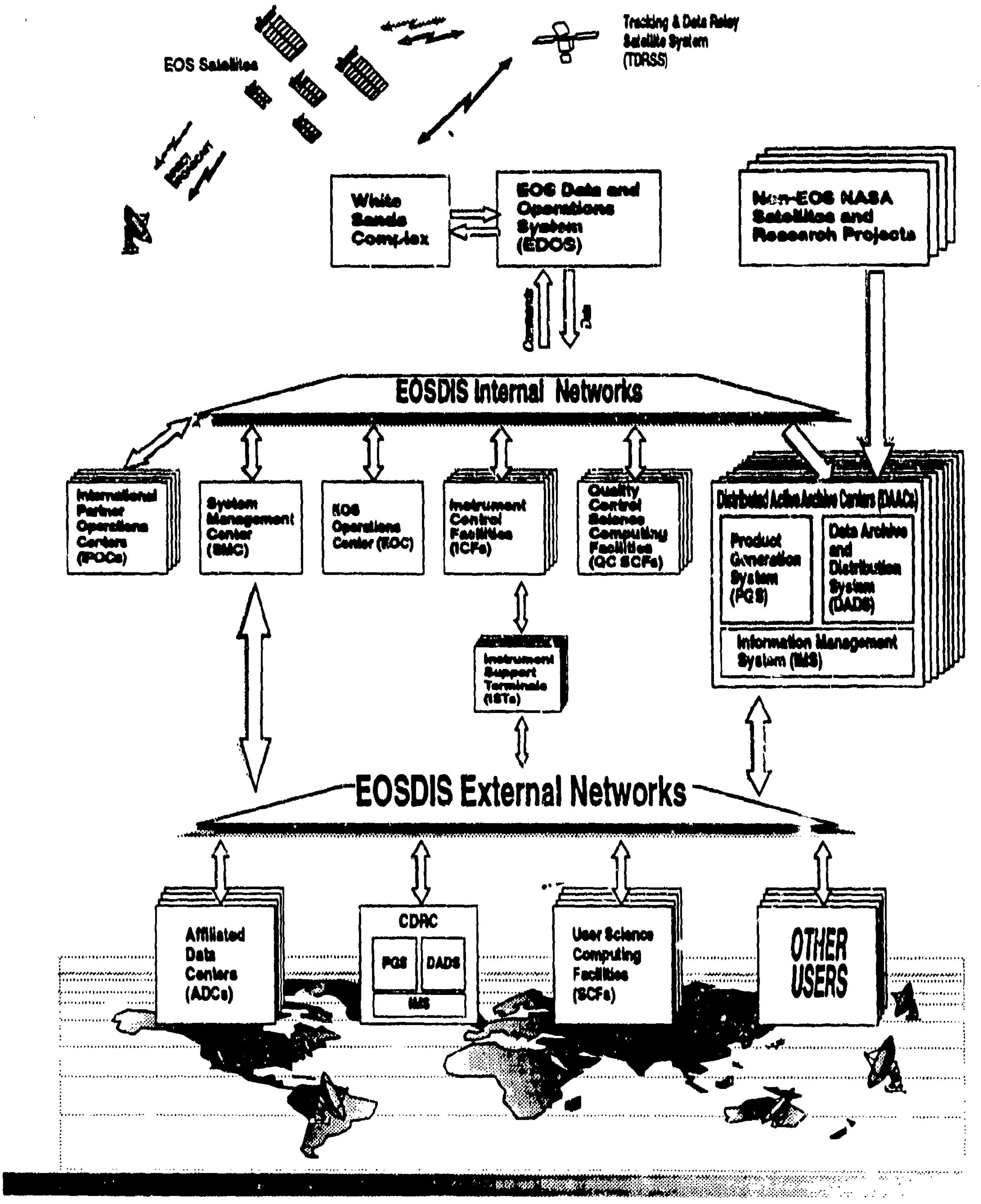
White Papers and Technical Papers

- 194-00285 A Glossary for the ECS Project,
- 193-00623 ECS Evolutionary Development,
- FB9404V2 Multi-Track Development for the ECS Project
- FB9402V2 ECS Science Requirements Summary
- 193-00611 Science-Based System Architecture Drivers for the ECS Project
- 194-00131 Defining the Architectural Development of EOSDIS to Facilitate Extension to a Wider Data Information System
- FB9401V2 ECS Science Information Architecture (March 94)
- 194-00287 Ancillary Data in the ECS - Study Report Version 1.1, March 1994
- 193-00136 Version 0 Data Migration and Translation Tool Analysis
- MR 9402V1 ECS Project Data Product Analysis: Early Results

White Papers and Technical Papers (Continued)

- MR9405V1 Flight Op[illegible]ations Segment Opertations Report Study
- MR9406V1 EOC/ICC Trade Study Report
- FB9405V2 System Management Service Distribution for the ECS Project
- AP9406V1 An Evaluation of OASIS-CC for Use in FOS for the ECS Project
- JU9403V1 Science Software Integration and Test
- JU9404V1 DAAC Facility Impact Analysis for Science Data Product Generation
- JU9406V1 SDPS Performance Requirements Interpretation

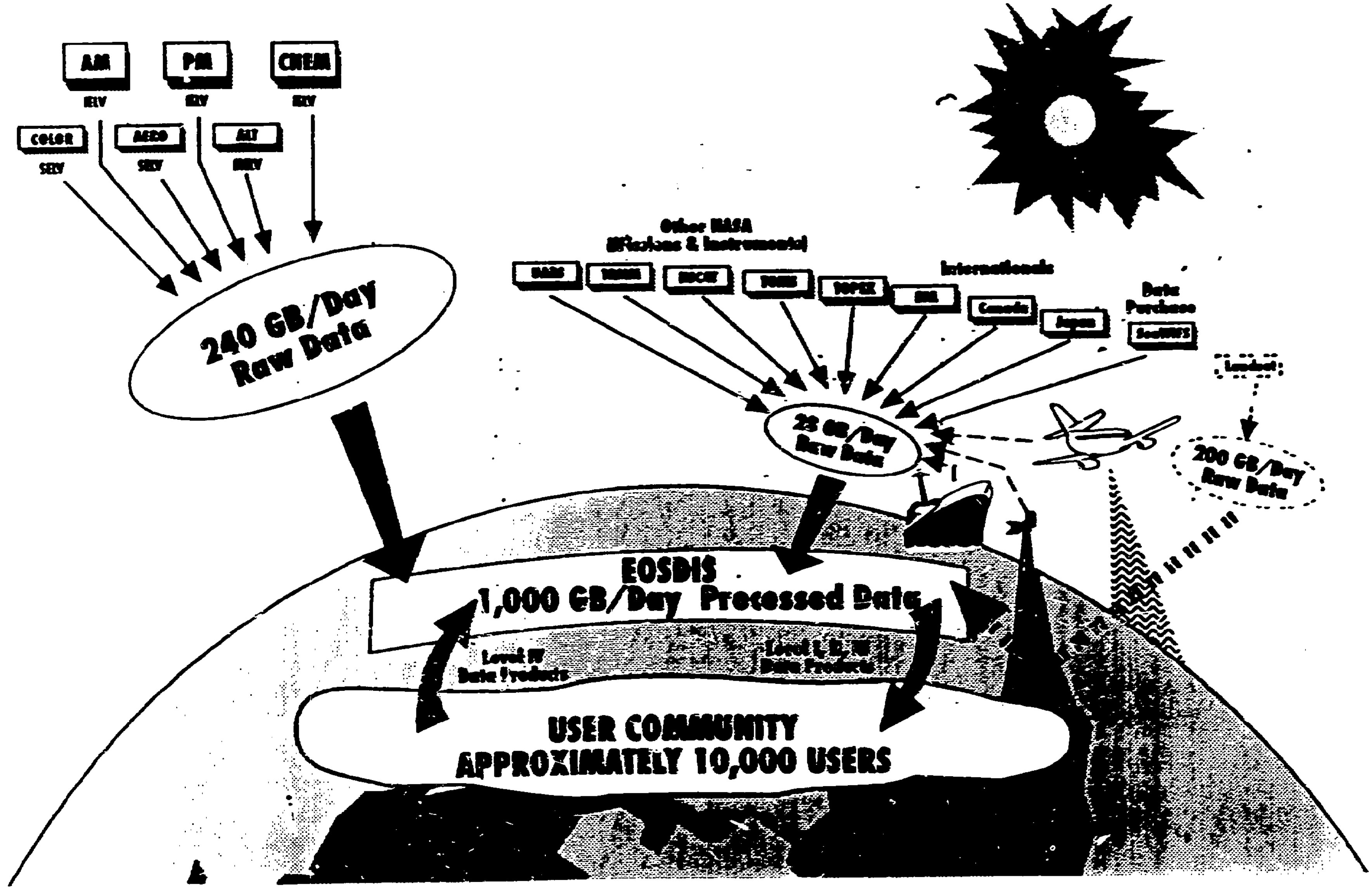
EOSDIS Architecture



CLEAR TOPPER

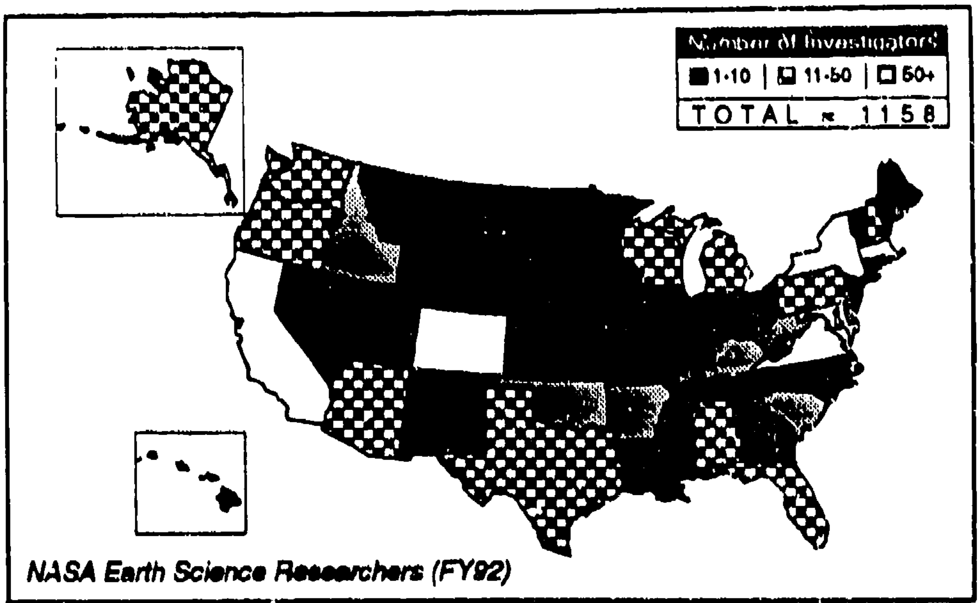
NASA

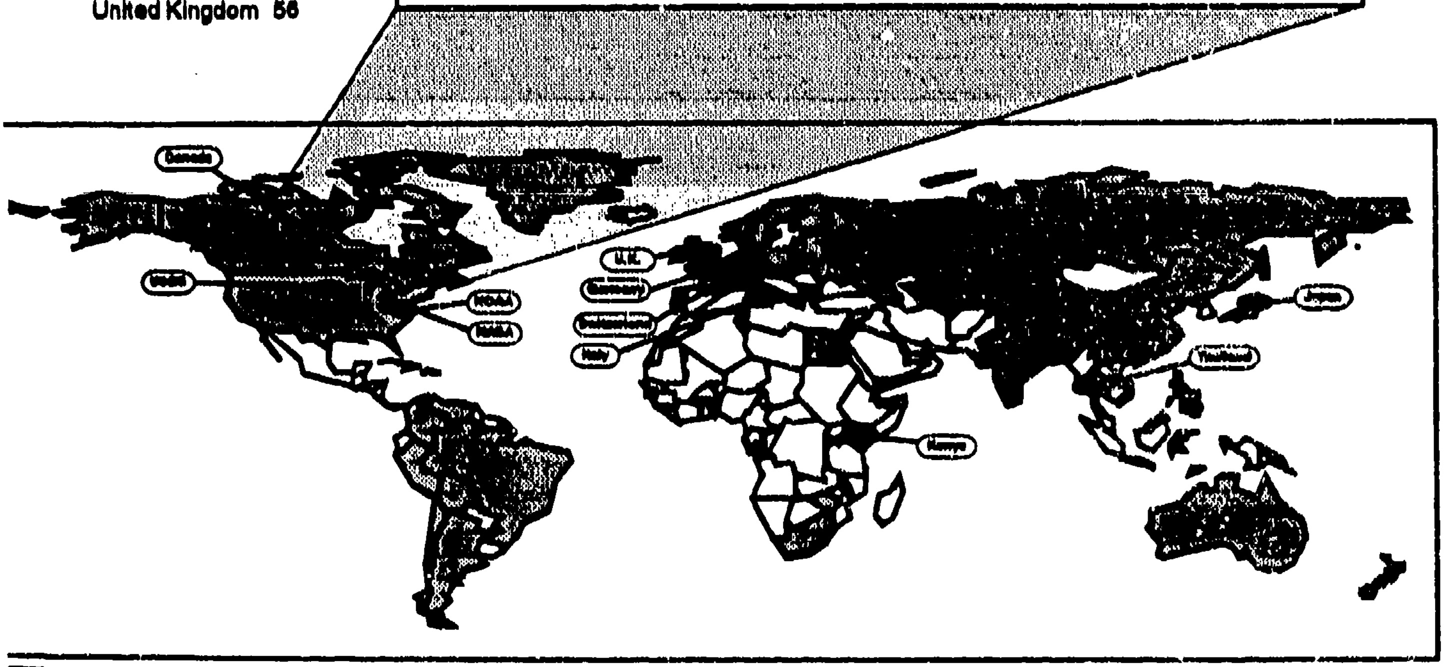
EOS Rescoped Program-Level Architecture



International Team Members

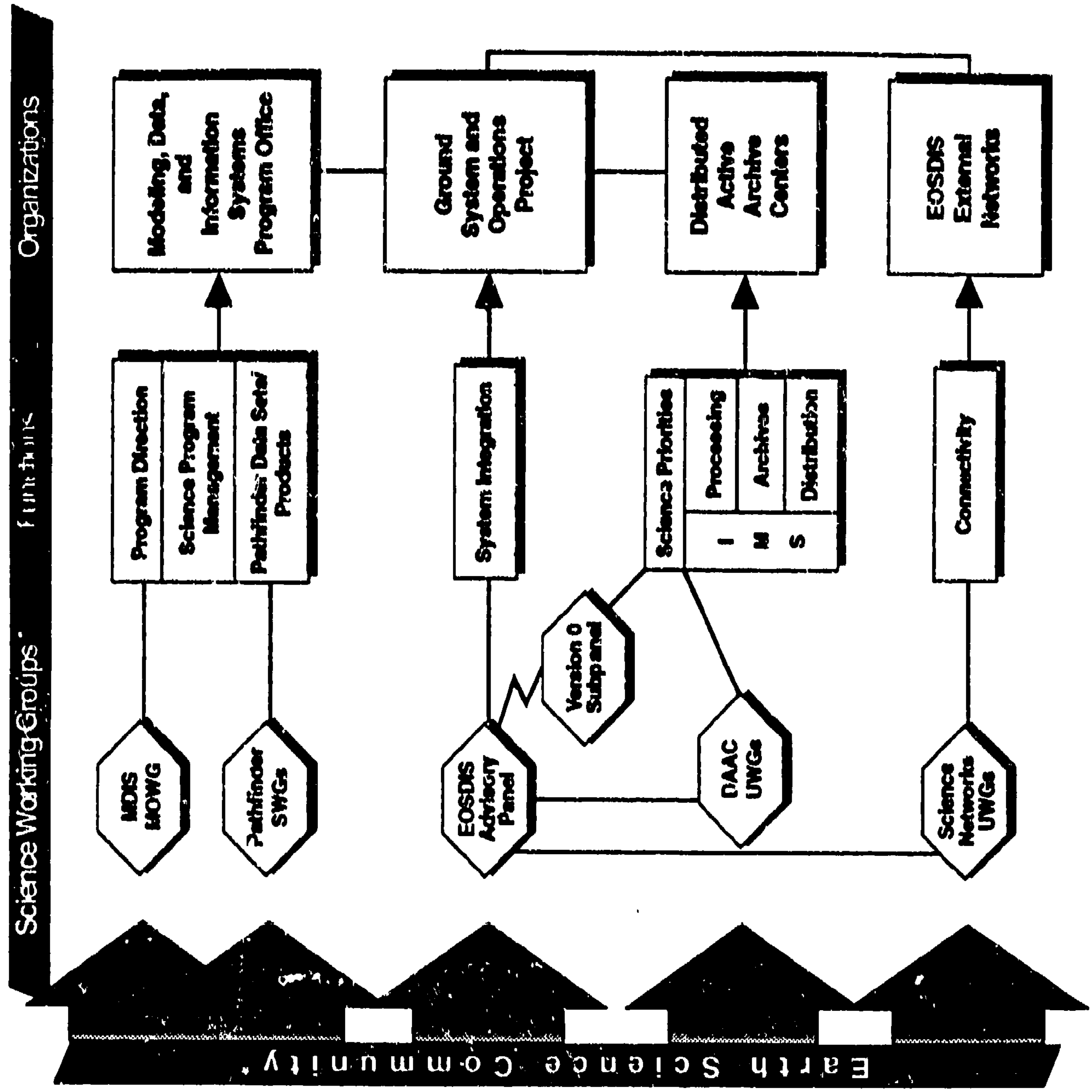
Australia	31
Belgium	2
Brazil	13
Canada	38
China	2
France	79
Germany	22
Hungary	5
India	2
Indonesia	1
Israel	1
Italy	36
Japan	55
New Caledonia	3
Norway	3
South Africa	3
The Netherlands	13
United Kingdom	56

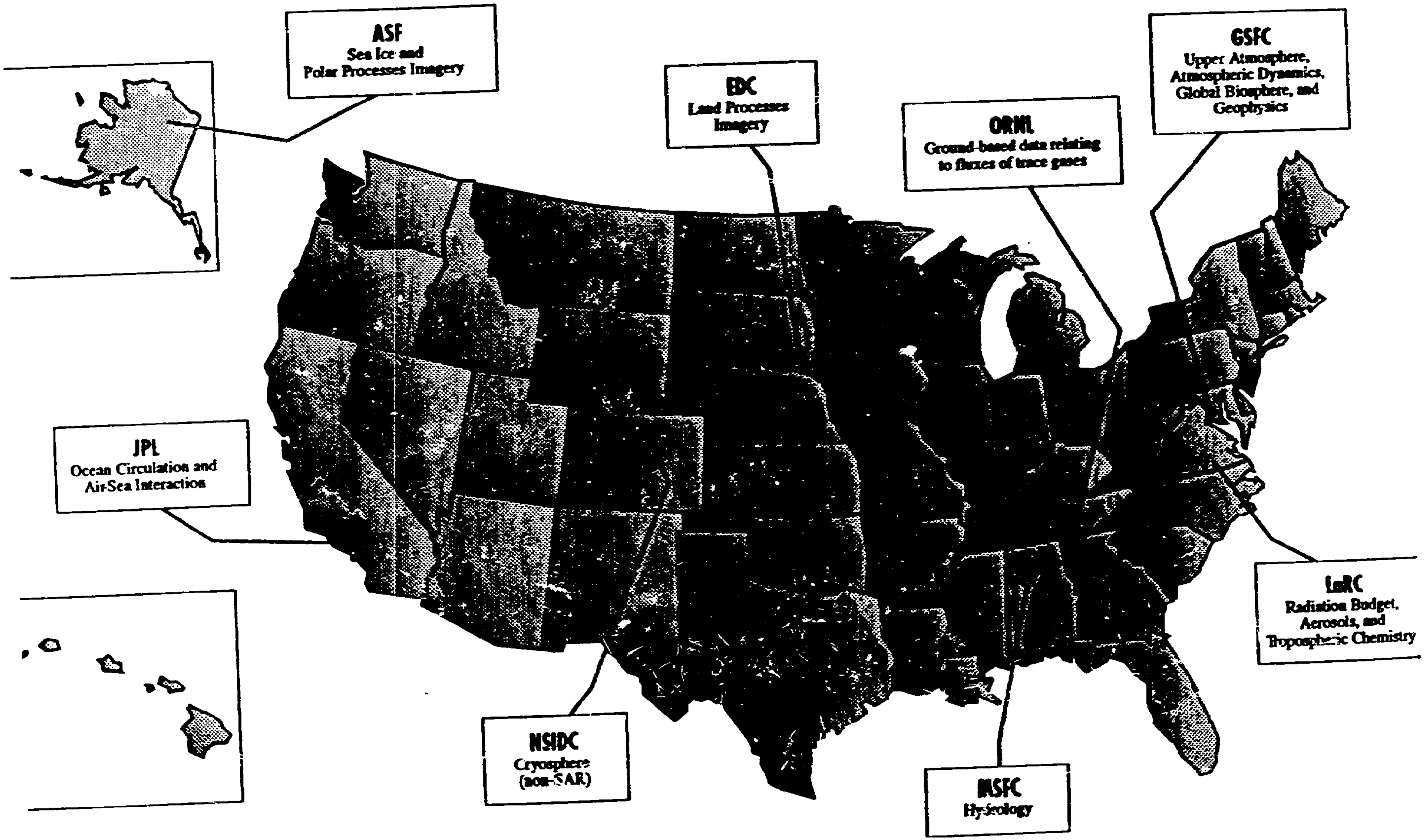




Participation in the International Geosphere-Biosphere Program (IGBP)
Location of CEOS and UNEP nodes for International Directories of Global Change Data

Scientific Participation in EOSDIS


Organizations
Functions
Science Working Groups*
Modeling, Data, and Information Systems Program Office
Ground System and Operations Project
Distributed Active Archive Centers
EOSDIS External Networks
Program Direction
Science Program Management
Pathfinder Data Sets/ Products
System Integration
Science Priorities
Processing
Archives
Distribution
I
M
S
Connectivity
Pathfinder SWGs
EOSDIS Advisory Panel
Version 0 Subpanel
DAAC UWGs
Science Networks UWGs
Earth Science Community*



Earth Science DAACs

17M 3/r

Earth

New Architecture Concept for EOSDIS

Martha E. Maiden
NASA Headquarters

CEOS WGD 16

Sao Jose dos Campos, Brazil
May 10-13, 1994

EOSDIS ➡ GCDIS/UserDIS

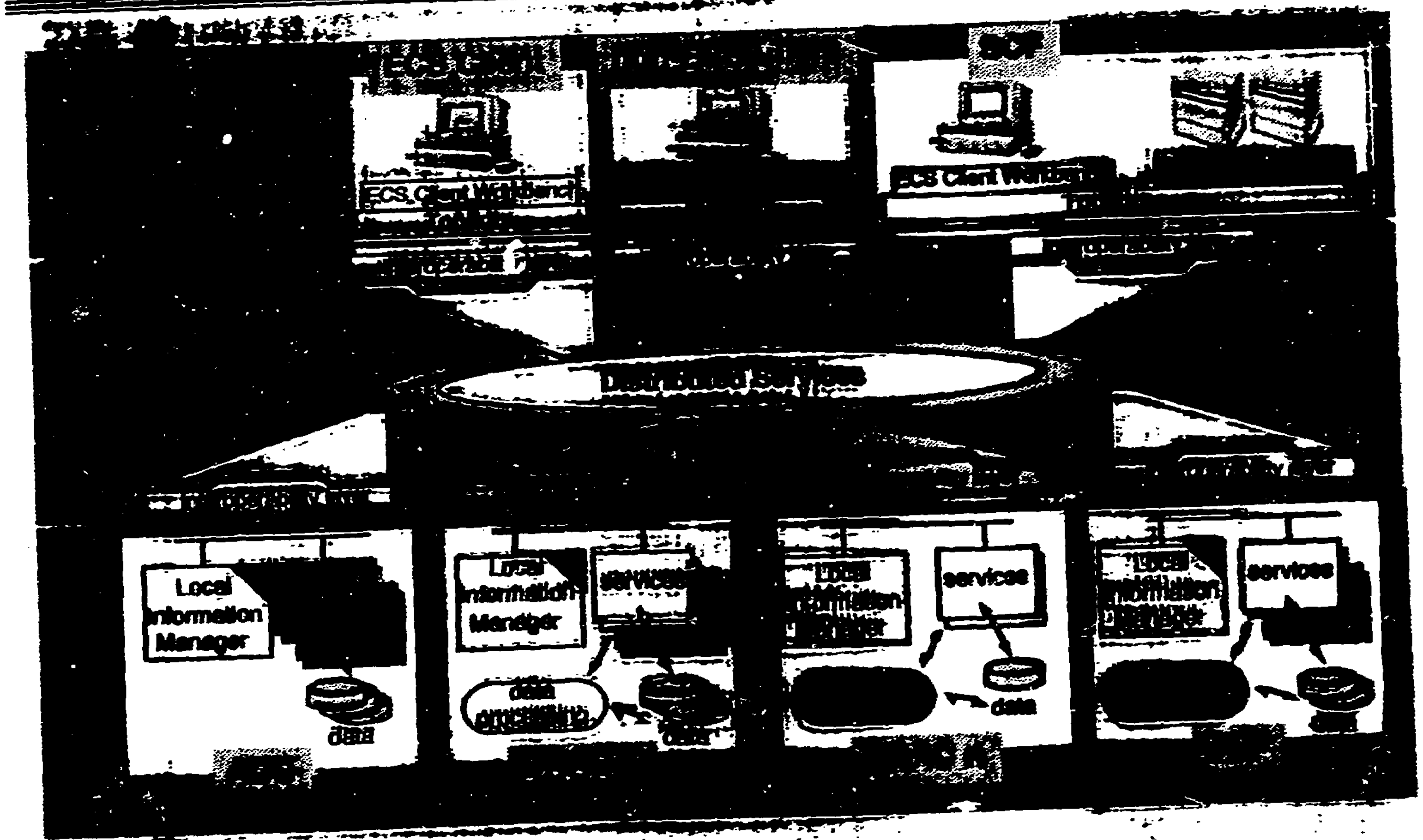
- **GCDIS**—Other sources of information outside of EOSDIS that are essential to global change research. Other global change agencies hold important data sets. GCDIS is intended to provide interoperability across the agencies to support data search and access.

- **UserDIS**—An Earth science data network in which the computer resources and expertise resident in the distributed user community are effectively utilized by removing the distinction between user and provider.

- **Study commissioned in response to user needs, vision of technological possibilities, and outside review committee comment.**

  - NRC—*"Provision of common GCDIS (and UserDIS) software, database structures, and technical infrastructure for an interoperable network."*

Science Data Processing Segment Architecture



Mandate

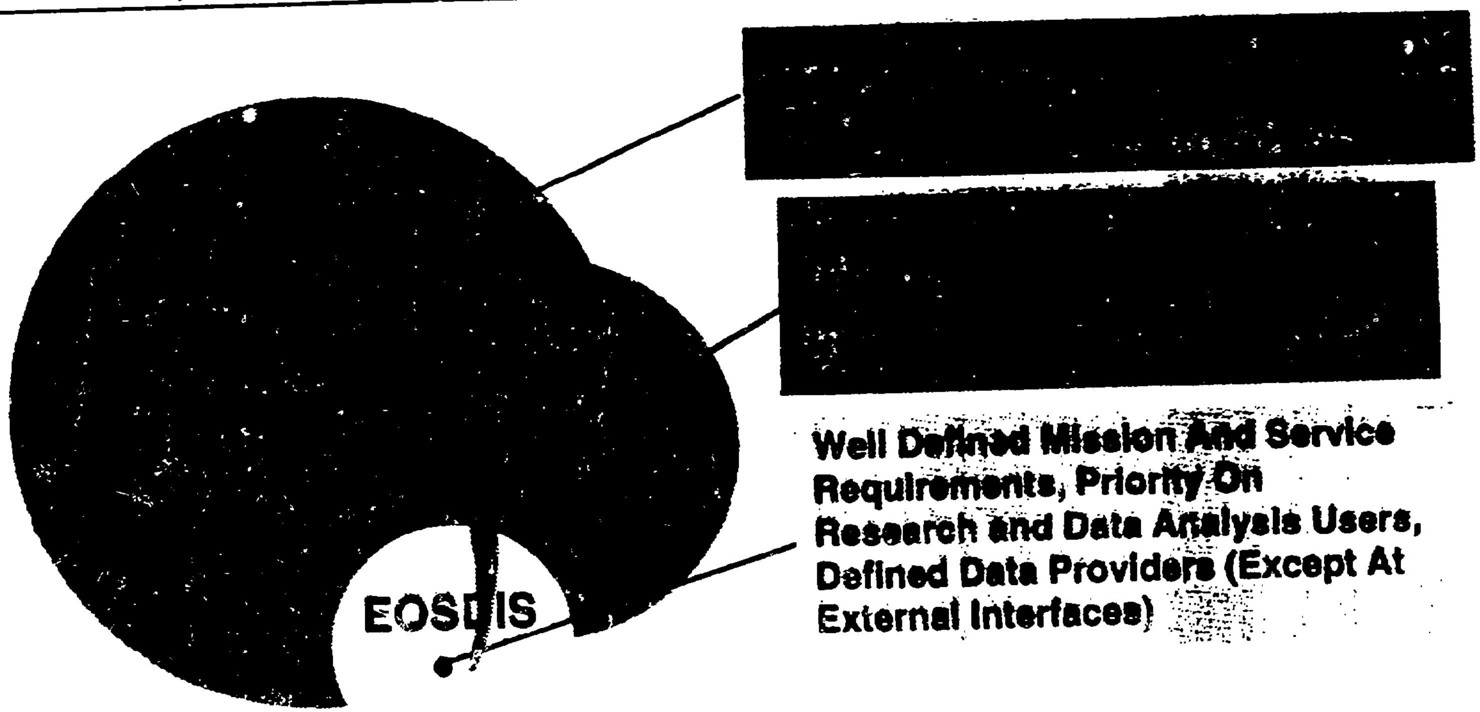
Based on interaction with the science community, ECS recast the baseline system architecture.

Move from ... [illegible] *...ds ...*

- ø Product approval [illegible] ...ct "publishing" and "access"
- ø Metadata / data di[illegible] ...s view of all data
- ø Limited provider l[illegible] provider implementation
- ø Homogenous, cen[illegible] ...geneous, autonomous system componen[illegible] ...em components

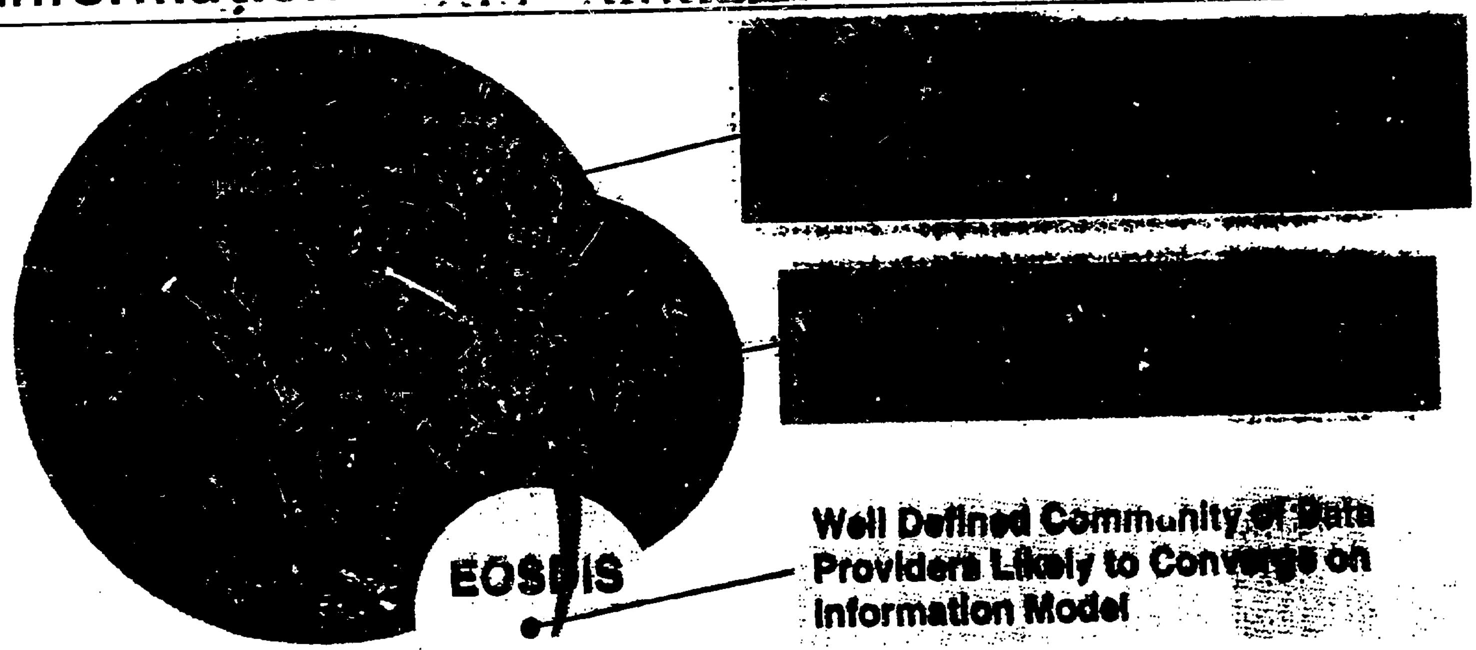
A more evolutionary system

User Model Concept



- objectives and missions of providers/users will differ widely
- should focus on earth science data and its users, but should not exclude other uses

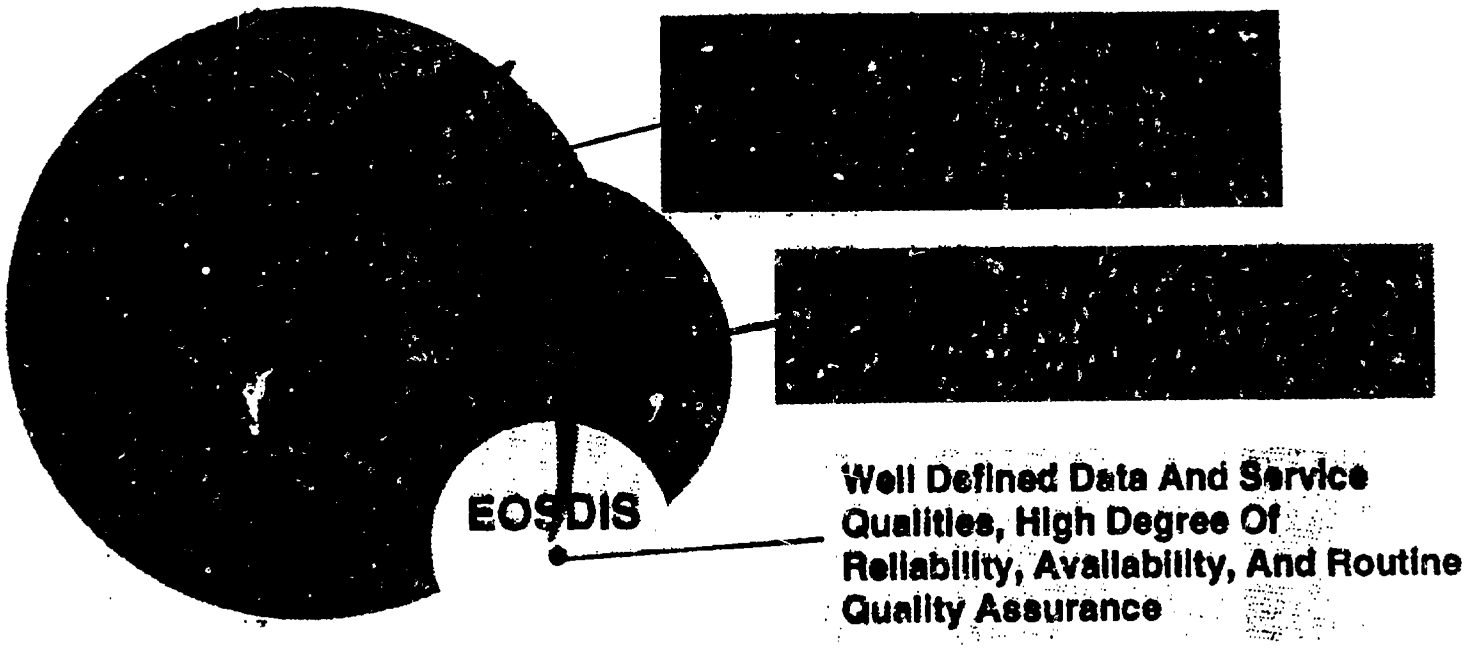
Information Model Concept



- should not assume a common information model or information management system
- development of standards is outside of EOSDIS scope, but may need to specify standard requirements for management and control of interoperability

MISSION TO PLANET EARTH

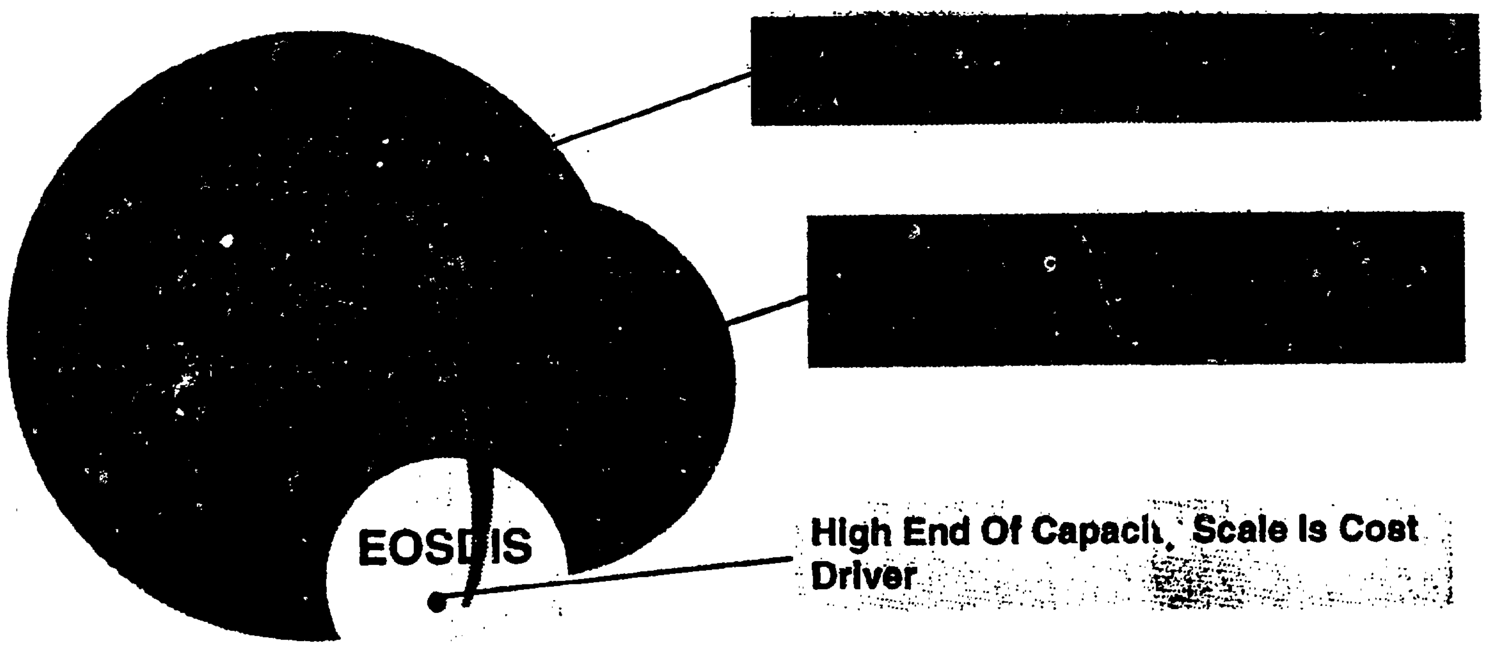
System Quality Concepts



- must be able to operate in environment which has no firm requirements for system quality factors (e.g., response time, throughput, availability, reliability, and accuracy)
- must include provisions which make it easier for users/providers to deal with such an environment

MISSION TO PLANET EARTH

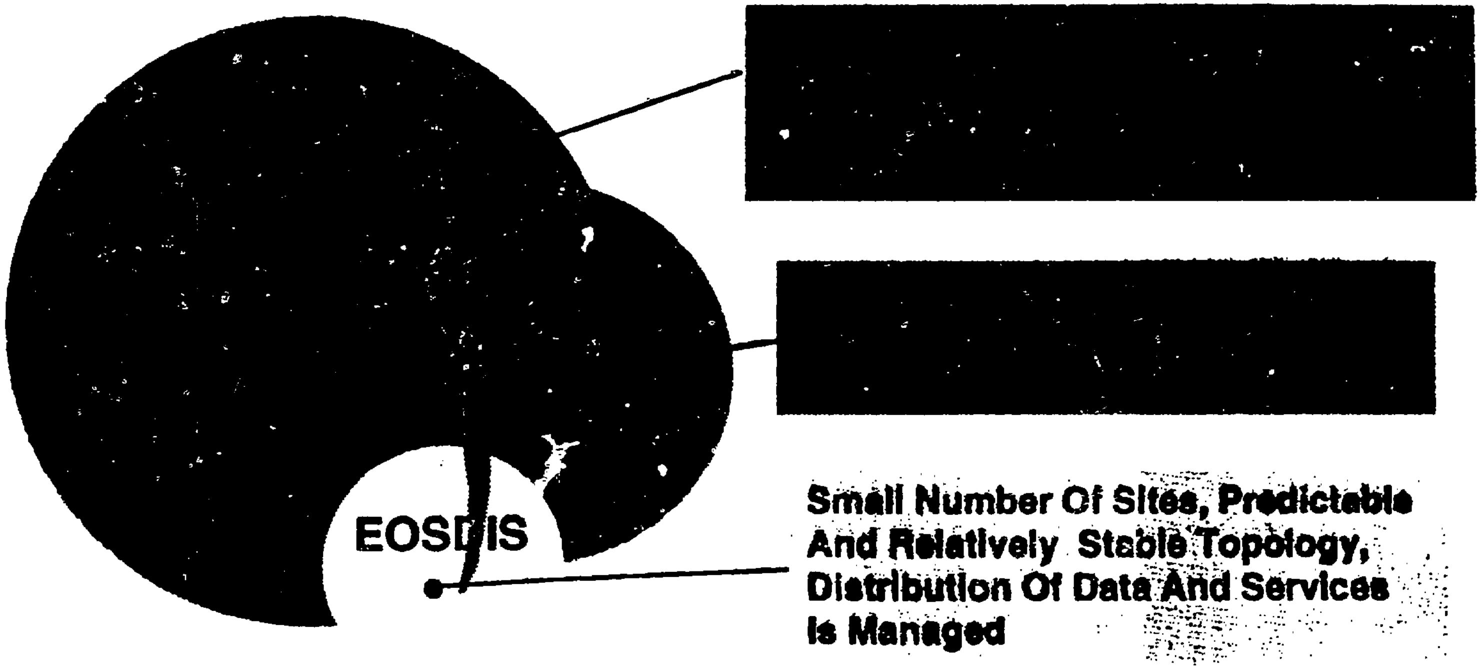
System Capacity Concept



- Need to develop solutions which scale (up/down) cost effectively
- should avoid limits on capacity which preclude low-end providers or restrict high-end providers

MISSION TO PLANET EARTH

System Distribution Concept

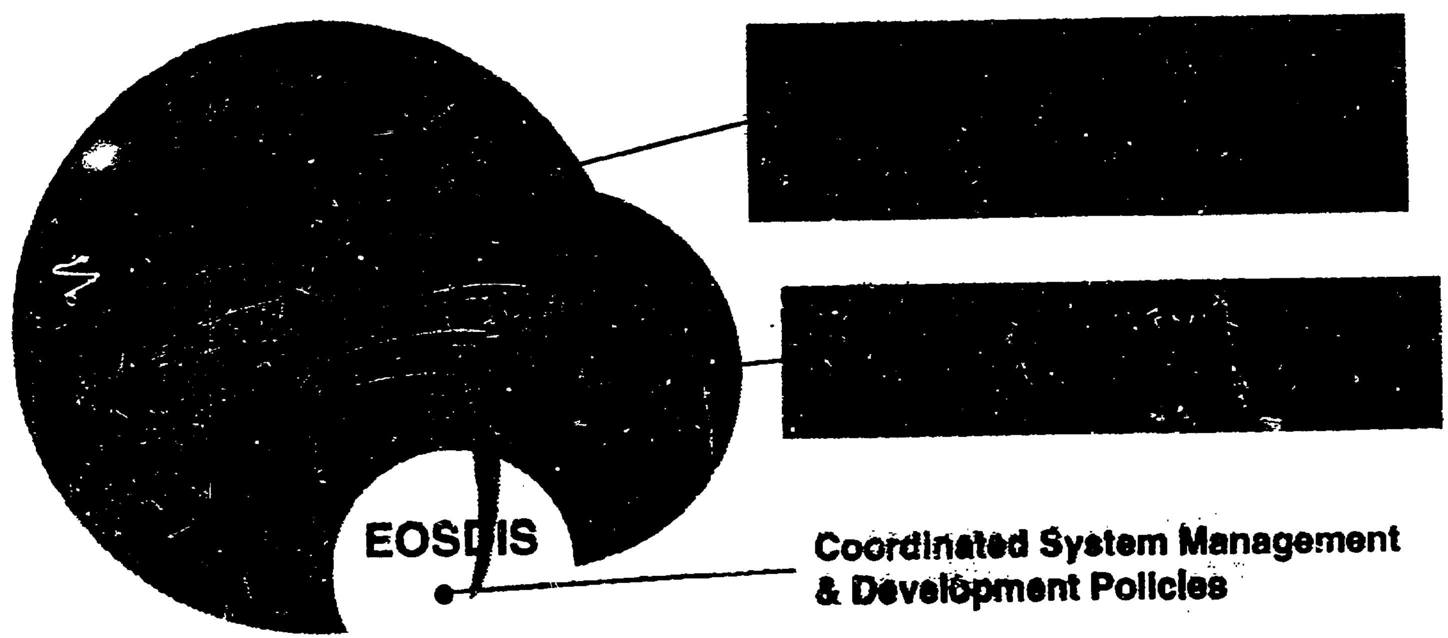


- should not assume any restrictions on the number of providers, their locations and the services and data they offer
- must be able to cope successfully with dynamic data and network topology

MTPE

MISSION TO PLANET EARTH

System Management Concept



- must accommodate autonomously managed provider sites
- should not assume a single management approach to development, operation, user authentication or data protection
- cannot rely on availability of network wide management information

MTPE

Catalog Interoperability

Workshop	Date	Attendees
First	1987	31
Second	1988	35
Third	1988	53
Fourth	1989	70
Fifth	1990	63
Sixth	1990	101
Seventh	1991	129
Eighth	1991	105
Ninth	1993	85
Tenth	1993	175
Eleventh	1994	185

Earth science funds supported CI [illegible] in part.

•GCMD client-server software provides directory level information on data sets of interest to the Earth science community. The directory level provides the first level in the data search.

•The GCMD is NASA's contribution to the interagency federation of directories known as the Global Change Data and Information System (GCDIS). The GCMD is presently the major working component of GCDIS.

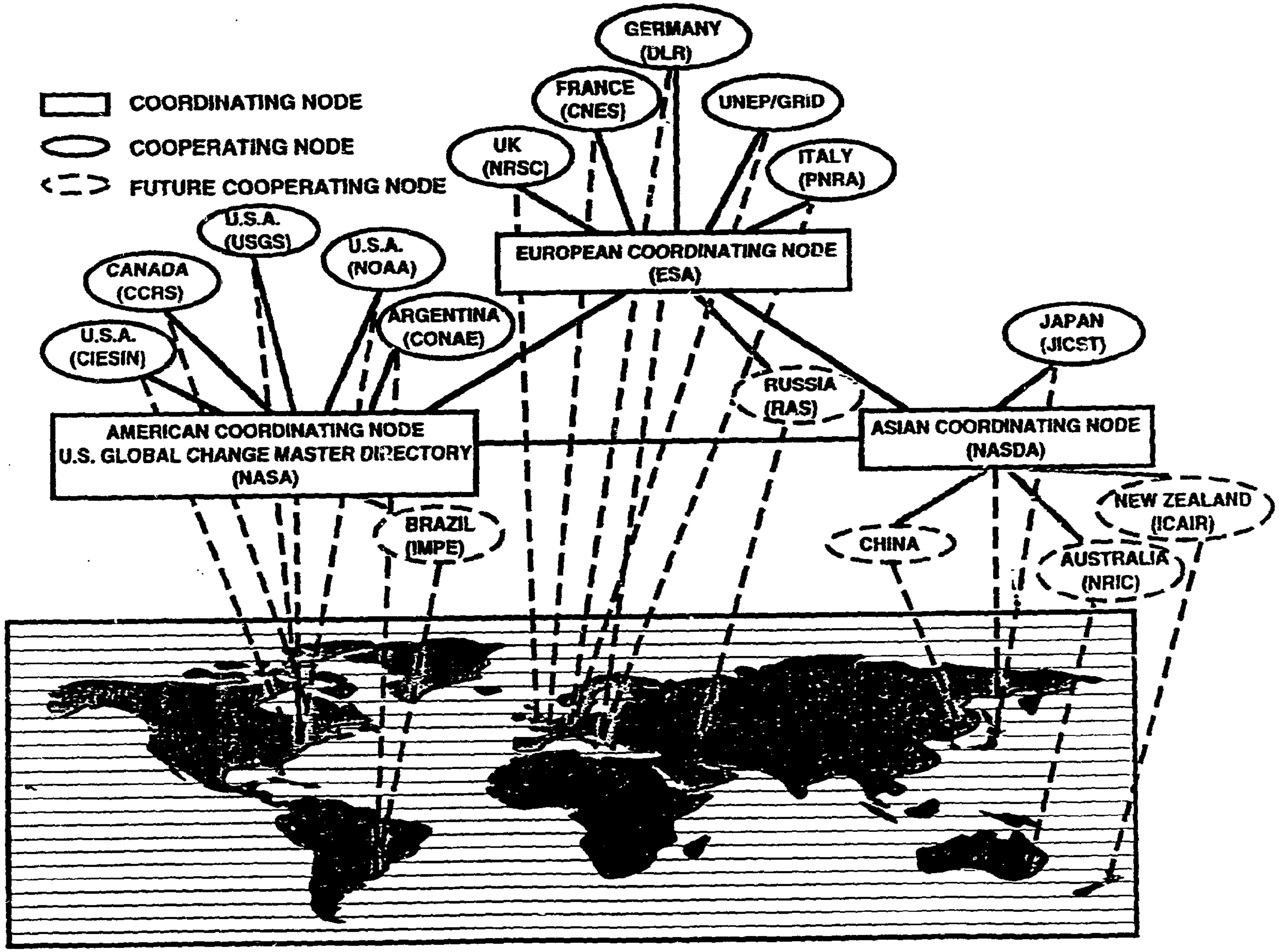
•The GCMD serves as the American Coordinating Node for the Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN). GCMD software is installed in many foreign countries, which function as IDN "nodes. These nodes provide a path for researchers within these countries to exchange information with the CEOS IDN.

•There is a concerted effort by science staff to write directory level entries, documenting data which recognizes U. S. Global Change Research Priorities and important data sets from around the world. Database entries are written in Directory Interchange Format (DIF).

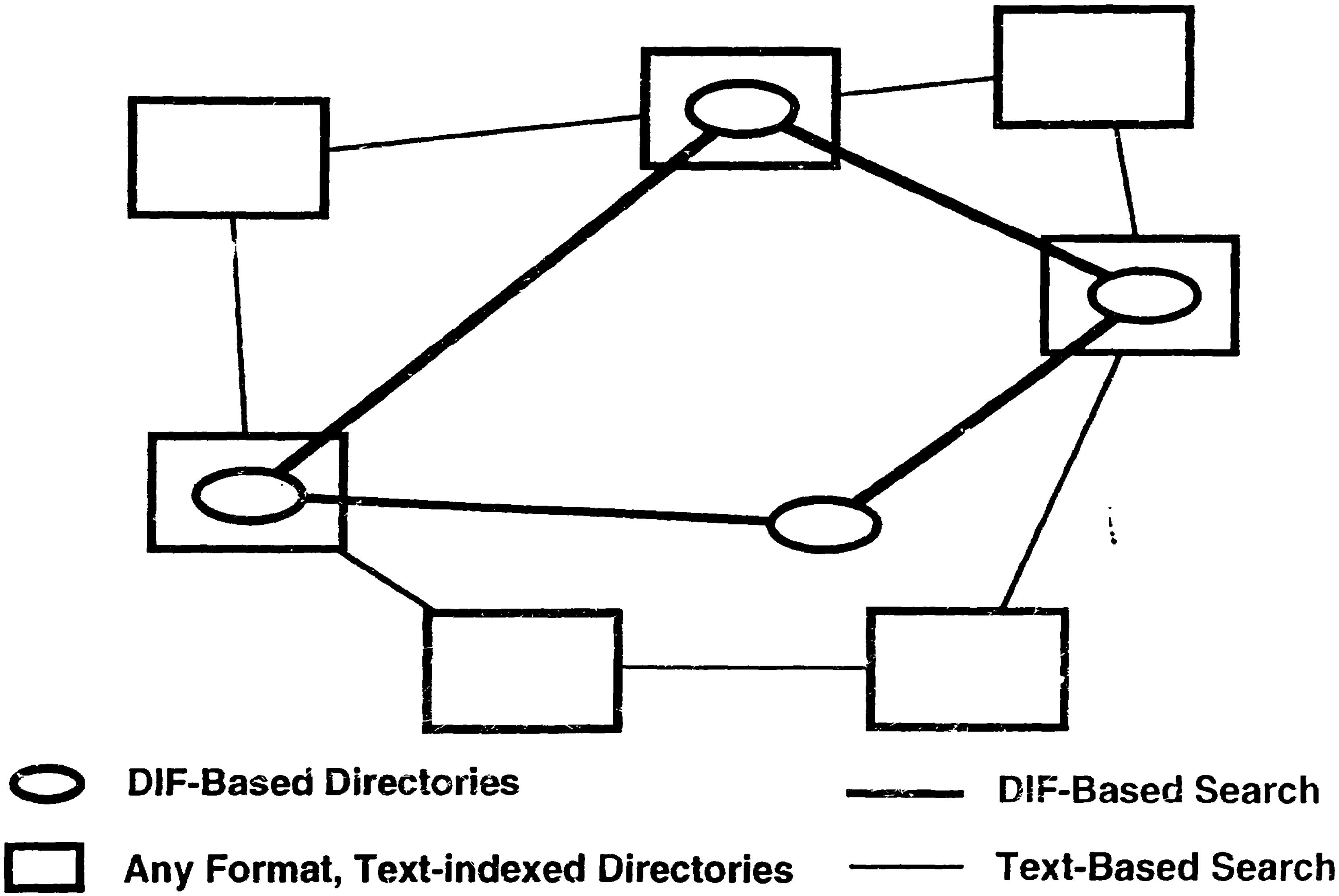
•Improving the search for information in locating data sets of interest is a prime concern.

•The GCMD functions within NASA's Mission To Planet Earth and is part of and accessible through EOSDIS.

Committee on Earth Observation Satellites' (CEOS)
INTERNATIONAL DIRECTORY NETWORK (IDN)



DISTRIBUTED DIRECTORY NETWORK



COMPREHENSIVENESS OF DIRECTORIES

Can the vast number of potentially relevant datasets ever be made locatable through the directories?

- DIF gathering and writing should and will continue
- DIF writing takes time and resources - must prioritize and delay some information entry
- Network search tools now enable indexing and text searching of electronic databases very quickly
- Most data archives have some electronic directory information about their holdings - even PC databases in developing countries
- Many archives already make data information available electronically through Gopher, WWW, etc.
- Some form of cross-archive (DIF and non-DIF-based) text searches in pre-selected areas of interest would be a useful service with warnings to user
- Gathering and indexing of offline electronic directory databases can be done at a low resource level
- Some of this is already being done and more should be encouraged

Global Change Master Directory

GCMD

by Lola M. Olsen

Perspective

The Global Change Master Directory (GCMD) is the organization within the Global Change Data Center responsible for coordinating Earth science directory level information at the interagency and international level and for developing software to facilitate the retrieval of this information by science researchers. The GCMD is NASA's contribution to the interagency federation of directories known as the Global Change Data and Information System (GCDIS) and presently the major working component of GCDIS. As the number of data sets held by university researchers, by federal agencies, and by foreign nations increases, the challenge of providing and maintaining current directory entries will grow. The GCMD must continue to cite data necessary for interdisciplinary global change research - "cutting across the disciplinary boundaries of oceanography, meteorology, climatology, land process studies, as well as transcending traditional Earth science discipline boundaries" - allowing researchers to readily obtain information about a variety of data sets for global change research.

Strategy

The ultimate strategy for the GCMD is to work toward a "distributed" system, whereby the directory can be automatically updated as data set holdings change at individual sites. Improving the current Directory Interchange Format (DIF) structure and incorporating the federally mandated "Content Standards for Digital Geospatial Metadata" will assist users in locating data of interest. Combining current GCMD search strategies with new search techniques, such as WAIS will also improve user access to appropriate information. Coordination of these efforts within the Mission to Planet Earth program is imperative in strengthening the validity of the direction for development and population.

In addition to its role within the interagency GCDIS, the GCMD will continue to serve as the American Coordinating Node for the Committee on Earth Observation Satellites (CEOS) International Directory Network (IDN). As the GCMD software is installed in more foreign nations that subsequently serve as IDN "nodes", reliable paths for researchers to exchange information will assist in increasing the knowledge of important and supporting data for global change research. In addition, making environmental information available to assist in policy decisions that will benefit future generations of people on Earth is a priority.

Major Milestones

August, 1994

Distribute Version II of the GCMD (Distribution Package 2 for the CEOS IDN) with new loader software and the X-window client.

March, 1995 (Second Quarter of FY 1995)

Distribute Version III of the GCMD (CEOS IDN Distribution Package 3) with the following: (1) operational version of the automated extractor for the autotransfer of DIFs to the CEOS IDN nodes, (2) operational version of a Unix-based DIF authoring tool for writing and editing DIFs, which incorporates loader to authoring tool, (3) operational version of WAIS, (4) an enhanced X client, and (5) improved geographic query.

September, 1995 (Fourth Quarter of FY 1995)

Distribute Version IV of the GCMD (CEOS IDN Distribution Package 4) with the following functionality: (1) prototype thesaurus interface to keywords, (2) prototype distributed GCMD database server, (3) extended WAIS functionality, (4) enhanced functionality of geographic query capability, recognizing the Content Standard for Digital Geospatial Metadata, and (5) support for additional protocols.

International Cooperation Yields Worldwide Operational Directory Capability

by Lola M. Olsen
Project Manger, U. S. Global Change Master Directory
Code 902, Global Change Data Center
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Introduction

Through the CEOS Working Group on Data, representatives from the American, Asian and European continents have collaborated to provide information about their countries' scientific data sets. This working group represents many agencies, universities, and other organizations within each country. The system of networked connections among the countries that offer and exchange data set information is called the CEOS International Directory Network (IDN). Earth science data set references presently dominate the directory. A recent brochure displays access, assistance, and other services available within each country's domain. The brochures are available through the Global Change Master Directory's (GCMD) User Support Office - Code 902, NASA/Goddard Space Flight Center, Greenbelt, MD 20771. One can also reach the user support office by phone: (301) 441-4202 or by FAX: (301) 441-9486, or through the Internet: mduso@gcmd.gsfc.nasa.gov. The American node of the IDN can be accessed by entering NCSA's Mosaic and clicking on the OPEN button. To access:

1. **The WWW Homepage for the GCMD**
   Enter **http://gcmd.gsfc.nasa.gov/intro.html**

2. **The GCMD Query Form**
   Enter **http://gcmd.gsfc.nasa.gov/gcmd.html**

3. **The DIF Writer's Guide on Mosaic**
   Enter **http://gcmd.gsfc.nasa.gov/difguide/difman.html**

Argentina Joins CEOS IDN As Cooperating Node

The CEOS IDN is an operational system with three coordinating nodes representing the international science community: (1) American - at NASA/Goddard Space Flight Center, Greenbelt, MD, USA; (2) Asian - at the National Space Development Agency of Japan (NASDA/EOC) in Saitama, Japan; (3) European - at the European Space Agency/European Space Research Institute (ESA/ESRIN) in Frascati, Italy. These coordinating nodes maintain duplicate copies of the database and the operational software. Japan (JICST), Canada (CCRS), France (CNES), Germany (DLR), the UK (NRSC), Italy (PNRA), countries represented by UNEP/GRID, and several agency nodes in the USA represented by NOAA, USGS, and CIESIN have each been considered "cooperating" nodes. These nodes provide a path for researchers within these countries to exchange information with the CEOS IDN. In March, 1994, a new cooperating node was installed in Argentina (CONAE). Russia, Australia, Brazil, New Zealand, and possibly China will join the network in the coming years. Several data set entries have already been received from these countries.

Commitment to Population of the Directory

Entries for the directory are submitted in a standard format, the Directory Interchange Format (DIF), providing standardized information on parameters, geographic and temporal coverage, data set location, and other summary information that can be automatically

loaded into the database. DIFs are submitted to the GCMD's discipline "coordinators", who quality-control submitted DIFs, as well as write DIFs for important data sets they identify. The value of the directory depends on current data set information, and the effort is committed to referencing data sets from as many available sources as possible. In addition, software to assist in formatting data set entries will be made available in the coming year.

New Version of Software Released

Usage statistics emphasize the increasing popularity of the directory, with more than 10,000 sessions logged between January and May, 1994. Directory users are offered several options for their interface to the client-server system, based on their terminal capabilities. A software update (CEOS IDN Installation Package, Version 2) was released on June 15th, 1994, which incorporates upgraded loader software and an X-Window client. Two additional releases are planned within the next year, which will include improved geographic search capability and an enhanced X-Window client.

The Future

Future plans include maintaining CEOS IDN node compatibility and integrity, increasing data set population, successfully integrating technological innovations, improving the geographical search, enhancing the X-Window client, incorporating the content standard for digital geospatial metadata with the DIF, and migrating the system to a "distributed" architecture. WAIS-based full text searching on the contents of the directory is planned, in addition to improved keyword searches.

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BMDO TESTS/EXPERIMENTS DATA MANAGEMENT LESSONS LEARNED

12 JULY 1994
DMSO I/DB MEETING

Presented By:

H. ALLEN HESS
for
OSD/JTAMS

PRA
Photon Research Associates, Inc.
1911 N. Fort Myer Drive #408
Arlington, Virginia 22209

PRA/HAH/JUL94/DMSO001.HAH-1

Photon Research Associates, Inc.

DATA MANAGEMENT FOUNDATION

- ESTABLISHING THE BMDO TEST DATA CENTERS (D/C)
- CONSOLIDATION OF ALL BMDO TEST/EXPERIMENT DATA
- CREATING THE DATA CENTERS STANDARDS COMMITTEE (DCSC) AND THE PHENOMENOLOGY SCIENCE AND ANALYSIS GROUP (PSAG)/USER PRODUCTS INFORMATION GROUP (UPIG)
- DRAFTING A DATA MANAGEMENT DIRECTIVE AND VISION
- PROVIDING CORE FUNDING TO SUPPORT DATA MANAGEMENT ACTIVITIES

PRA Photon Research Associates, Inc.

DATA CENTER VISION

- SERVE AS CENTERS OF EXCELLENCE; LOCATED AT DoD CENTERS OF EXPERTISE
- THREE MAJOR SERVICES REPRESENTED
- NECESSARY TO MAXIMIZE PRODUCTIVITY AND MINIMIZE EXPENSES FOR THOSE ACCESSING AND ANALYZING SCIENTIFIC DATA.
- PAST AND ONGOING LESSONS LEARNED WILL CONTRIBUTE TO THE EFFECTIVENESS OF THE DATA CENTERS OPERATION
- DATA CENTERS ARE THE FOCUS OF DATA MANAGEMENT AND NOT ONLY SERVE AS PRIMARY ARCHIVES, BUT FACILITATE ANALYSIS BY PROVIDING TIMELY ACCESS TO WELL DOCUMENTED AND VALIDATED DATA AND DATA PRODUCTS
- SATISFY FEDERAL REGULATIONS REQUIRING THE PRESERVATION OF DATA COLLECTED FROM FEDERALLY FUNDED PROJECTS

PRA/HAH/JUL94/DM80001.HAH-3

PRA Photon Research Associates, Inc.

SOME D/C LESSONS LEARNED

- SECURE A COMMITMENT TO SUPPORT THE D/C FROM ALL LEVELS OF MANAGEMENT AND THE USER COMMUNITY
- STANDARDIZE ACROSS ALL D/C - USE PROVEN INDUSTRY/FEDERAL GUIDELINES AND STANDARDS
- DURING THE EARLY STAGES OF DEVELOPMENT ESTABLISH DISTRIBUTED DBMS/CLIENT-SERVER CAPABILITIES.
- ENSURE PERMANENT FUNDING SOURCE; PROMOTE CAPABILITIES
- PARTICIPATE IN DATA MANAGEMENT STRATEGIES DURING THE PLANNING STAGES OF TESTS AND EXPERIMENTS
- ALWAYS ENSURE THAT YOU ARE MEETING THE NEEDS OF YOUR USER COMMUNITY; PRODUCE D/C USERS GUIDES

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MANAGEMENT OF TEST/EXPR DATA
BMDO DIRECTIVE No. 3240

- ESTABLISHES POLICY FOR THE MGMT OF PHENOMENOLOGY, ENGINEERING, BATTLE MGMT COMMAND, CONTROL, AND COMMUNICATIONS (BM/C^3), AND OTHER TECHNICAL DATA
- MAINTAINS D/C AS A SERVICE TO THE TECHNICAL COMMUNITY AND TO SATISFY FEDERAL REGULATIONS
- MANDATES THAT RELEASE AUTHORITY FOR ALL DATA AND RELATED INFORMATION SHALL ACCOMPANY ANY DATA SET, ARCHIVE PACKAGE, OR OTHER DELIVERABLE MADE TO ONE OR MORE D/C
- DIRECTS THAT ALL TEST/EXPR DATA INCLUDING FOLLOW-ON ANALYSES SHALL BE DELIVERED TO THE APPROPRIATE D/C ON A TIMELY BASIS
- ENSURES THAT THE DATA/INFORMATION RESIDENT IN THE D/C REPOSITORIES WILL NOT BE DUPLICATED BY NEW TESTS

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BMDO DIRECTIVE No. 3240 CONTINUED

- INSTITUTES THE D/C AS THE CORE OF THE TEST/EXPERIMENT DATA MANAGEMENT PROCESS, AND ACCORDINGLY ENSURES SOUND DATA MANAGEMENT PRACTICES ARE BEING ENFORCED
- ORGANIZES THE D/C AS REPOSITORIES FOR BMD DATA AND THAT EACH MAINTAINS A CENTER OF EXPERTISE RELEVANT TO THE NATURE OF THEIR DATA
- ESTABLISHES THE ROLES AND RESPONSIBILITIES OF BMDO DIRECTORATES, TEST MGRS, D/C MGRS, DCSC, PSAG/UPIG, ETC.
- INSTITUTES DATA MGMT PROCEDURES AND REPORTING REQUIREMENTS
- PROVIDES GUIDELINES FOR REPORTING REQUIREMENTS

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BMDO DIRECTIVE No. 3240
SOME LESSONS LEARNED

- DISCUSS SALIENT POINTS OF DATA MGMT WITH EACH OFFICE, AGENCY, OR ORGANIZATION WHICH IS A POTENTIAL APPROVING AUTHORITY
- BE SURE TEST AND EXPERIMENT MANAGERS ARE INCLUDED IN THE COORDINATION PROCESS
- UNDERSTAND CLEARLY FEDERAL REGULATIONS RELATING TO DATA MANAGEMENT
- MAINTAIN CONCISE DOCUMENT CONTROL ON DIRECTIVE
- ENSURE ALL ASPECTS OF SOUND DATA MGMT ARE DETAILED DURING THE EARLY DRAFTS SO PROGRAMS CAN CALCULATE THEIR DATA MGMT COSTS AND ALLOCATE THE APPROPRIATE FUNDS
- CONFIRM DEFINITIONS ARE CONSISTENT WITH NOT ONLY WITH INDUSTRY STANDARDS BUT INTERNAL STANDARDS AS WELL

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D/C STANDARDS COMMITTEE RESPONSIBILITIES

- PROVIDE A FORUM FOR DISCUSSIONS, ANALYSES, TRADE STUDIES, AND RECOMMENDATIONS CONTRIBUTING TO THE STANDARDIZATION OF SOFTWARE, HARDWARE, AND OTHER SYSTEMS RESOURCES AT AND AMONG THE D/C AND OTHER BMDO DATA FACILITIES AS REQUIRED
- DEFINE AND PROMOTE DATA STANDARDS
- MAINTAIN DATA INTERCHANGE STANDARDS AMONG D/C, ADDRESS INTEROPERABILITY ISSUES, AND DEVELOP STANDARDS FOR ACHIEVING INTEROPERABILITY
- EXAMINE ALTERNATIVES AND STRATEGIES FOR ACHIEVING OPTIMUM UTILIZATION OF THE D/C AND THE DATA THEY HOLD
- COORDINATE DATA MANAGEMENT POLICY FOR TEST/EXPERIMENT DATA MANAGEMENT
- STANDARDIZE OR FURTHER DEFINE/CLARIFY DATA MGMT TERMS

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BMDO DCSC
SOME LESSONS LEARNED

- ESTABLISH A CHARTER FOR THE DCSC
  - PROVIDE A FORMAL MECHANISM UNDER WHICH THE COMMITTEE OPERATES
  - CLARIFY COMMITTEE/SUBCOMMITTEE RESPONSIBILITIES
  - FURNISH A MEANS BY WHICH THE COMMITTEE CAN ADDRESS AN ISSUE, APPROVE/DISAPPROVE ANY CONCLUSIONS, AND SUBSEQUENTLY ACT UPON ANY DECISIONS
- PARTICIPATING ORGANIZATIONS MUST APPROPRIATELY SPONSOR MEMBERS, i.e. PROVIDE ADEQUATE LOE
- ATTEMPT TO HAVE CONSISTENT MEMBERSHIP (CONTINUITY)
- FOCUS MORE ON DISCRETE PROJECTS THAT ARE BOUNDED... NOT OPEN-ENDED DISCUSSIONS OR INVESTIGATIONS
- TAKE A PROACTIVE ROLE IN ISSUES RELATING TO DATA MGMT
- FOCUS ON THE DATA AND ACCESS

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BMDO PSAG/UPIG

- DETERMINE AND SATISFY USER REQUIREMENTS
- COMMUNICATE PRODUCTS AND SERVICES OF THE DATA CENTERS TO INTERESTED PARTIES
- PROVIDE A FORUM FOR USER INPUT TO THE DATA MANAGEMENT PROCESS AND DISCUSSIONS RELATING TO DATA ANALYSES
- INTERFACE WITH THE DCSC AND D/C
- ASSIST IN DEVELOPING DATA PRODUCTS
- DEVELOP D/C STRATEGIES IN COLLABORATION WITH D/C MGRS
- CONDUCT USER SURVEYS
- SERVE AS AN INTERFACE BETWEEN THE USER COMMUNITY AND THE D/C

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PSAG/UPIG
SOME LESSONS LEARNED

- PREPARE PROMOTIONAL INFORMATION ON THE D/C AND BMDO TEST/EXPR DATA MGMT
- ASSIST THE D/C IN BECOMING TRUE CENTERS OF EXCELLENCE
- PERIODICALLY EVALUATE D/C, DCSC, AND UPIG RESULTS SO IMPROVEMENT IS BUILT INTO THE PROCESS
- PROVIDE A UNIFORM LOOK AND FEEL INTERFACE AND DEVELOP A MASTER (SUMMARY) CATALOG COMMON TO ALL D/C
- LISTEN TO THE USERS; ATTEMPT TO PROVIDE ACCESS TO THE DATA AT THEIR OWN SITES
- ASSIST WITH ISSUES RELATING TO DIRECTIVE No. 3240
- AID IN THE TRANSFER OF CATALOG INFORMATION, METADATA, AND DATA TO OTHER AGENCIES (e.g. NASA)

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SECURITY LESSONS LEARNED

- CLASSIFICATION OF AGGREGATE DATA
- RELEASE AUTHORITY OF BMDO EXPERIMENT DATA
- FOREIGN PARTICIPATION IN BMDO EXPERIMENT PROGRAMS
- ACCESS AND DISTRIBUTION OF CLASSIFIED DATA AT D/C
- SECURITY ISSUES AND USER SUPPORT

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OTHER LESSONS LEARNED

- SELECTING PARTICIPANTS FOR THE DCSC AND UPIG
- MAINTAIN A THOROUGH INVENTORY OF DATA
- ASSESS THEIR SCIENTIFIC VALUE
- COPY VALUABLE DATA AND RELEASE UNNEEDED TAPES
- MAINTAIN ADEQUATE ARCHIVING FACILITIES (NARA REGS)
- DEVELOP AND IMPLEMENT APPROPRIATE STANDARDS
- CLEARLY DEFINE MANAGEMENT ROLES AND RESPONSIBILITIES
- ENSURE THAT PERIODIC OVERSIGHT IS PERFORMED
- ALLOCATE ADEQUATE RESOURCES TO DATA MANAGEMENT AND ARCHIVING ACTIVITIES
- DO NOT LET POLITICS PREVENT ACCESS TO DATA

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WHAT WE HAVE ACCOMPLISHED
PARTIAL LISTING

- APPROVED DCSC CHARTER; D/C USER GUIDES
- COMPLETED DEVELOPMENT OF A COMMON USER INTERFACE AND SUMMARY CATALOG
- GENERATED A D/C FUNDING PLANNING BOOK
- PRODUCED A STANDARD IMAGE DISPLAY FORMAT
- EXPERIMENT DATA ARCHIVE LOCATION MATRIX
- DATA CENTER HW/SW CONFIGURATION MATRIX COMPLETED
- HIGH VOLUME MASS STORAGE STUDIES
- SECURE TECNET CONNECTIVITY
- DATA CENTER USER SURVEY

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WHAT WE HAVE ACCOMPLISHED
PARTIAL LISTING CONTINUED

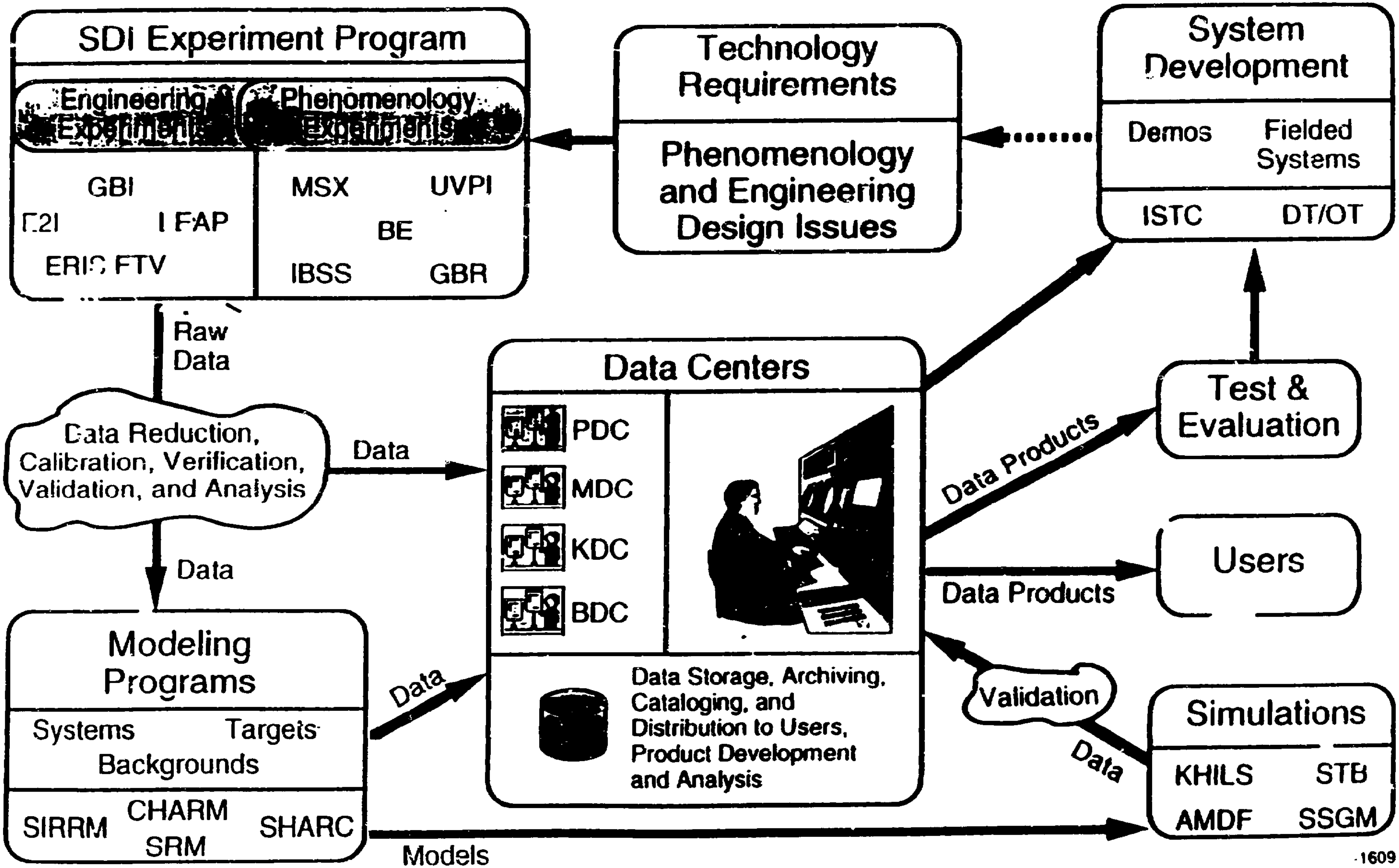
- PRODUCED A FAIRLY ROBUST KEYWORD LIST FOR USE WITH SUMMARY CATALOGS AND DATABASE SEARCHES
- DEFINED TEST/EXPERIMENT DATA LEVELS TO ASSIST WITH DATA PROCESSING AND ARCHIVING DECISIONS
- AUTOMATED EXPERIMENT SUMMARY AND OVERVIEW PROGRAM
- VALIDATION ACTIVITIES (e.g. EVALUATING SSGM SCENES AGAINST EXPERIMENT DATA)
- ANALYZING DATA AND PROVIDING UNIQUE DATA VIEWS TO USERS
- ADOPTED A SET OF RECOGNIZED STANDARDS
- STANDARDIZED SW, HW, & PROCEDURES THROUGH THE DCSC
- ASSISTED IN DEFINING THREAT SIGNATURES

PRESENT/FUTURE DATA MGMT FOCUS

- FIRST UPDATE TO BMDO DIRECTIVE No. 3240 CURRENTLY IN COORDINATION
- GREATER EMPHASIS ON VV&C OF DATA
- REVIEW OF DATA FOR USE IN MODELING AND SIMULATION
- LARGE VOLUMES OF DATA TO BE ARCHIVED
- D/C FUNDING- MAINTAINING OPERATIONS UNDER SHRINKING BUDGETS
- D/C CONNECTIVITY AND INTEROPERABILITY
- RESOLUTION OF DATA MGMT SECURITY ISSUES

BALLISTIC
MISSILE
DEFENSE
ORGANIZATION

SDIO MANAGEMENT OF EXPERIMENTAL AND MODELED PHENOMENOLOGY DATA



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UNCLASSIFIED DRAFT

C2 CORE DATA MODEL

Briefing to Modeling and Simulation IDB Meeting

12 July 1994

Dr. Robert P. Walker
Institute for Defense Analyses
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Key IDA Contributors: Dr. Gene Simaitis, Dr. Franciso Loaiza

Sponsorship of Data Modelling at IDA:

- DASD(IM) and Joint Staff J6V—GCCS and Integrated C2 Data Models (1994-95)
- U.S. Representative to ATCCIS [U.S. Army ODISC4, OASD(C3I)-T&TC3]— Generic Hub and Fire Support Data Model (1992-95)
- DISA/JIEO/TBCE (Information Directorate, Center for Standards)—Fire Suport Data Model and C2 Core Data Model (1992-93)

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FOCUS OF BRIEFING

- ROLE OF DATA MODELS
- ENTERPRISE DATA MODEL
- C2 CORE DATA MODEL
- C2 SUBFUNCTIONAL AREA DATA MODELLING
- CHALLENGES FOR FUTURE C2 DATA MODELLING

PURPOSE OF DATA MODELS

- PROVIDE A HIGH-LEVEL SPECIFICATION OF:
  - Information inputs and outputs of functional processes
  - Information items subject to exchange (e.g., between staff cells)

- PROVIDE CONSISTENT BASIS FOR DATA ELEMENT STANDARDIZATION

OPERATIONAL BENEFITS

- DATABASES FOR C2 SYSTEMS
  - Consistent data standards lead to
    - Improved database design
    - Better accessibility
    - Potential for lower long-term system costs
  - Database-to-database exchange is key to operation of modern tactical C2 information systems
- INTEROPERABILITY
  - Consistent data standards provide necessary basis for specifying information exchange
    - Database-to-database
    - Messages, whether automated or manual
  - Integration of information exchange standards requires a common, consistent data model
    - TADILs
    - Message text formats
    - Variable message formats
    - Internal system exchanges (e.g., FACTs)

STANDARDIZATION POLICY

- DoD OPERATIONS SHALL BE EXECUTED THROUGH INTEGRATED AND STANDARD DEPARTMENT-WIDE
  - Processes
  - Data definitions
  - Information systems

  IN SUPPORT OF JOINT WARFIGHTING AND PEACETIME MISSIONS (DoD INSTRUCTION 8020.1)

- DATA STANDARDIZATION SUPPORTS (DoD 8320.1, 8320.1-M-1)
  - Providing clear, concise, consistent, unambiguous, easily accessible data DoD-wide
  - Minimizing the cost and time required to transform, translate, or research differently described, but otherwise identical, data
  - Data sharing and interoperability among information systems throughout the DoD
  - Uniform description and representation of data

- DATA ELEMENT STANDARDIZATION (DoD 8320.1-M-1)
  - Designed to represent the attributes (classification) of data entities identified in data models
  - Definition based on data entities and their associated attributes established in the DoD Data Model
  - Reflects a single concept to promote shareability and data independence for application

SCOPE OF DATA MODELS

- **DATA MODELS DO NOT LIMIT THE CHOICE OF REPRESENTATIONS FOR:**
  - Storing data physically in a system (e.g., database structure)
  - Presenting data to users (human-computer interface)
  - Presenting data to communications systems (e.g., protocols)
  - Exchanging data internally within an automated system

- **DATA MODELS DO NOT LIMIT THE CHOICE OF LANGUAGE FOR**
  - Users (e.g., French, English)
  - Programmers
  - Database query

RELATION TO ZACHMAN'S FRAMEWORK FOR INFORMATION SYSTEMS ARCHITECTURE

		DATA	FUNCTION	NETWORK
REQUIREMENTS	Objectives/ Scope	What is important to know?	What processes are performed?	Where are the operations conducted? (C2IEs, OPFACs)
	Model of the Business	Entities and relationships	Data flows (input, output) [USAFAS Red Book]	Nodes and links (need lines) [FIA]
	Model of the Information System	Conceptual Data Model - Entities - Relationships - Attributes (and keys) [IDEF1X]	Activity Model - Processes - Input/Output - Controls - Mechanisms [IDEF0]	Distributed (System) Architecture
IMPLEMENTATION	Technology Model	Data Design (database specification)	Structure Chart & Detailed Design Specifications	System Architecture (with hardware specifications)
	Detailed Representations	Data Design Description (fields, addresses)	Program Description (code, documentation)	Network Architecture Specifications (addresses, processes)
	Functioning System	e.g., DATA	e.g., FUNCTION	e.g., COMMUNICATIONS

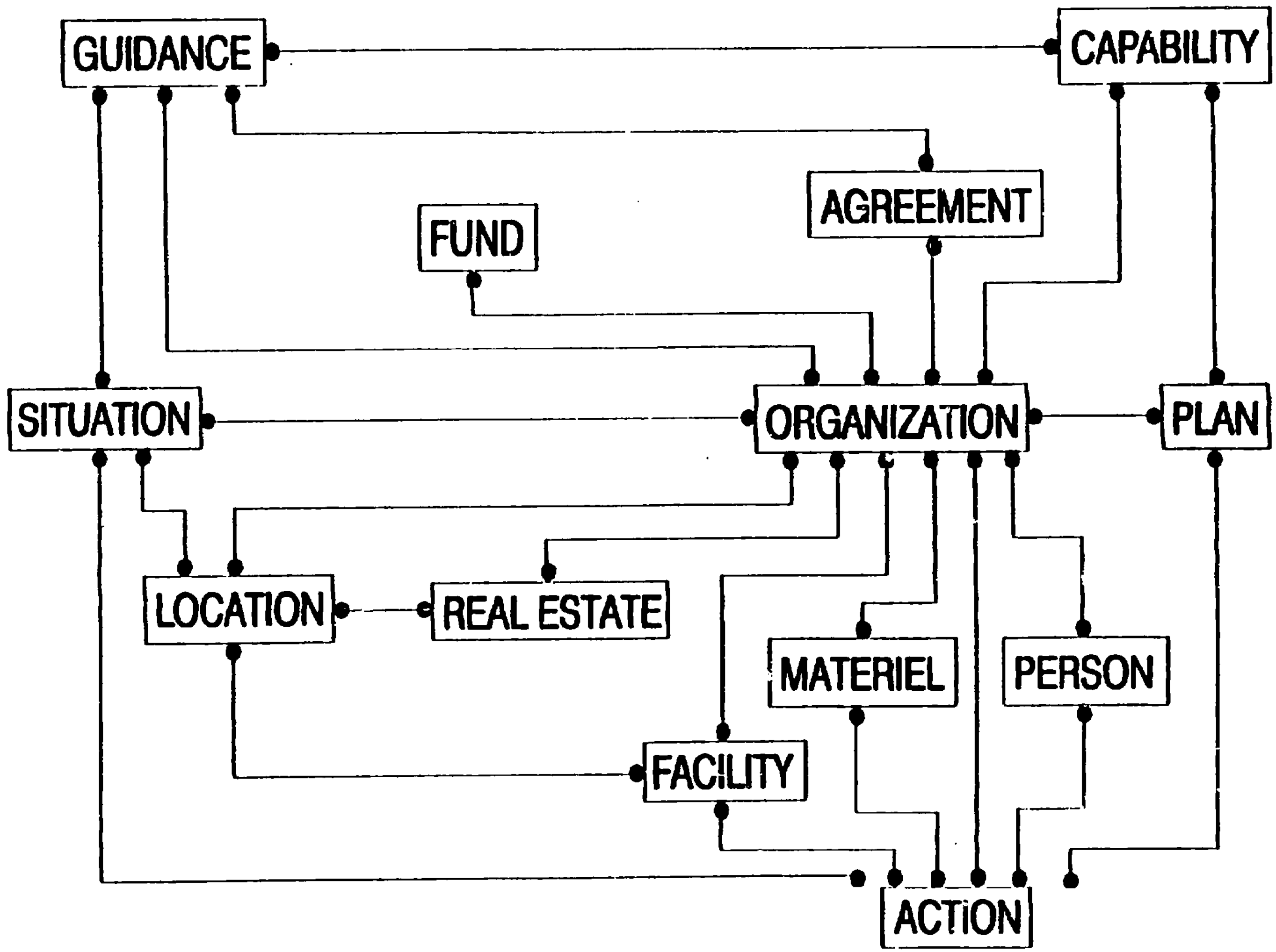
ROLE OF DoD ENTERPRISE MODEL

- PROVIDES A DEFENSE ENTERPRISE-LEVEL VIEW OF THE DoD DATA MODEL
- DoD DATA MODEL IS A SINGLE INTEGRATED DATA MODEL FOR THE DoD
- DoD DATA MODEL CONSISTS OF APPROVED ENTITIES AND ATTRIBUTES UNDER DoD 8320.1-M-X PROCEDURES
- EDITION 2 OF THE ENTERPRISE MODEL (JAN 94) SHOWS HOW FEATURE, POINT, LINE, AREA, VOLUME, CAPABILITY-NORM, AND DOCUMENT CAN BE INTEGRATED INTO THE DoD DATA MODEL
- QUARTERLY EDITIONS OF DoD DATA MODEL ARE PLANNED (BEGINNING JUNE/JULY 1994)

* JIEO/DAPMO INTEGRATES C2 AND OTHER FUNCTIONAL AREA DATA MODELS INTO THE DoD DATA MODEL

DoD Enterprise Model

STRUCTURE OF DoD ENTERPRISE MODEL



BACKGROUND FOR C2 CORE

- MANDATED BY THE MILITARY COMMUNICATIONS-ELECTRONICS BOARD OF THE JOINT STAFF
- DEVELOPED BY DISA WITH SUPPORT FROM ODISC4 AND CONTRACTORS; RELEASED 1 SEP 93
- EXCLUDES OBJECT-ITEM AND OBJECT-TYPE TO SIMPLIFY INTEGRATION TO THE DoD DATA MODEL
- PROVIDED TO C2 COORDINATION COMMITTEE (CDAds, FDAds, AND OTHERS) FOR REVIEW IN FALL 1993
- HAS BEEN RECOMMENDED FOR USE BY EXECUTIVE AGENTS FOR C2 FDAd AND INTEL FDAd (AND US ARMY ODISC4)

* SERVES AS A CORE FOR MODEL DEVELOPMENT AND INTEGRATION

CONCEPTS UNDERLYING C2 CORE DATA MODEL

- FOCUS SHOULD BE ON DATA FOR THE ELEMENTS OF THE BATTLEFIELD AND THEIR EMPLOYMENT (ACTIONS)
  - Battlefield elements (OBJECTs) comprise: PERSON, UNIT, MATERIEL, FEATURE, FACILITY
  - Activities employ objects both as resources and as objectives: "Use these objects against these objects (targets)"
  - Battlefield objects occur both generically (by type) and specifically (by item)
    -- To specify targets
    -- To describe what is established (e.g., for a unit) and what is actually held
    -- To describe what is needed and what is allocated to carry out a plan to achieve an objective

CONCEPTS UNDERLYING C2 CORE DATA MODEL (Cont'd)

- **FOCUS SHOULD BE ON DATA FOR THE ELEMENTS OF THE BATTLEFIELD AND THEIR EMPLOYMENT (ACTIONs) (Cont'd)**
  - Objects can be located in a single way (LOCATION)
  - Activities can be grouped and structured (as ACTIONs) to specify:
    - Subactions, modified actions, and (time) dependent actions
    - Plans, orders, and requests (e.g., fire plan)
    - Events
- **THERE IS A COMMON CORE ("C2 CORE") UNDERLYING THE C2 FUNCTIONAL AREA**
  - If specified in one way, the core could provide a basis for integrating subfunctional areas
  - Fire Support Data Model is first extension of the common core
  - A single data model is possible (with many user views)

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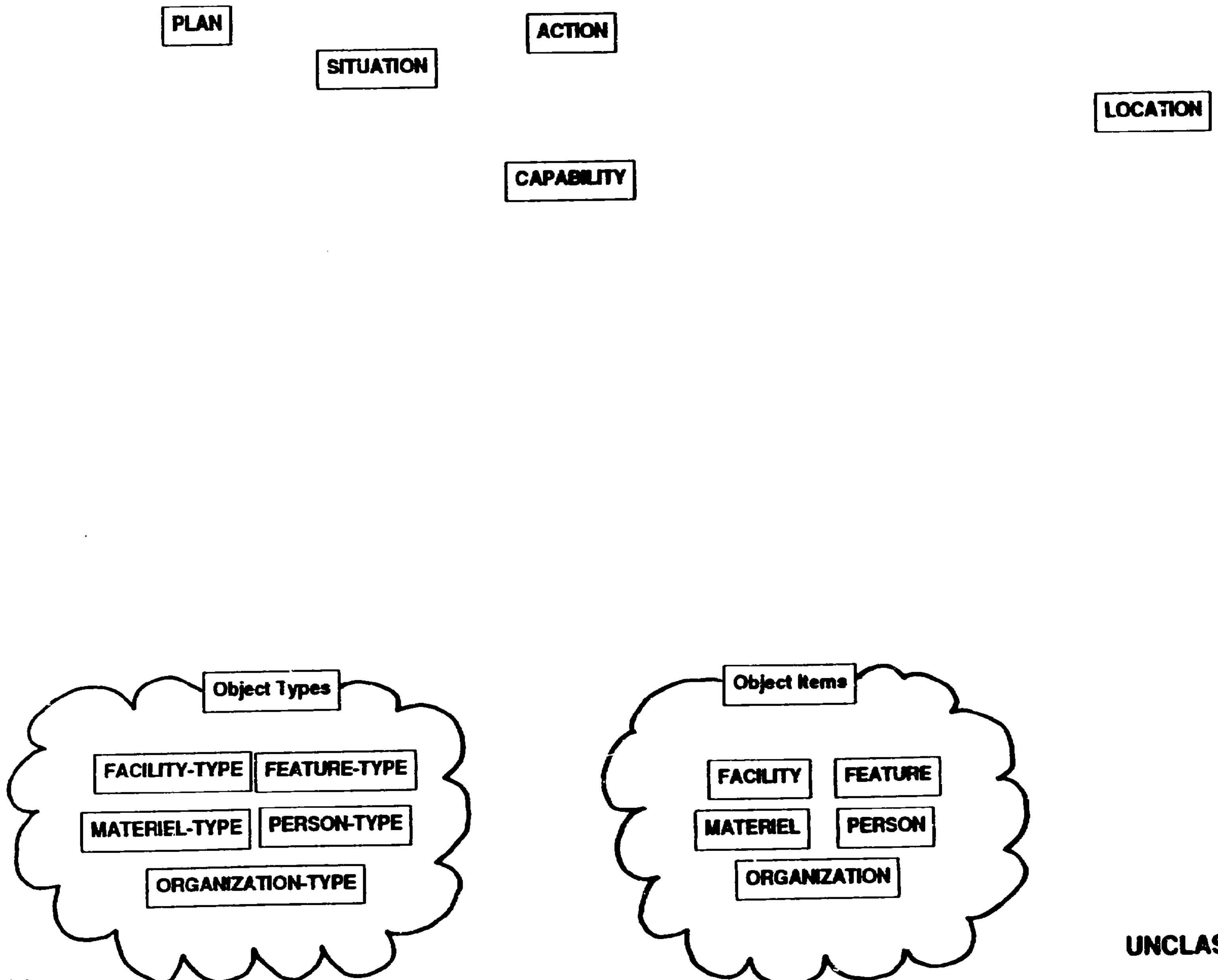
1. C2 CORE–INDEPENDENT ENTITIES



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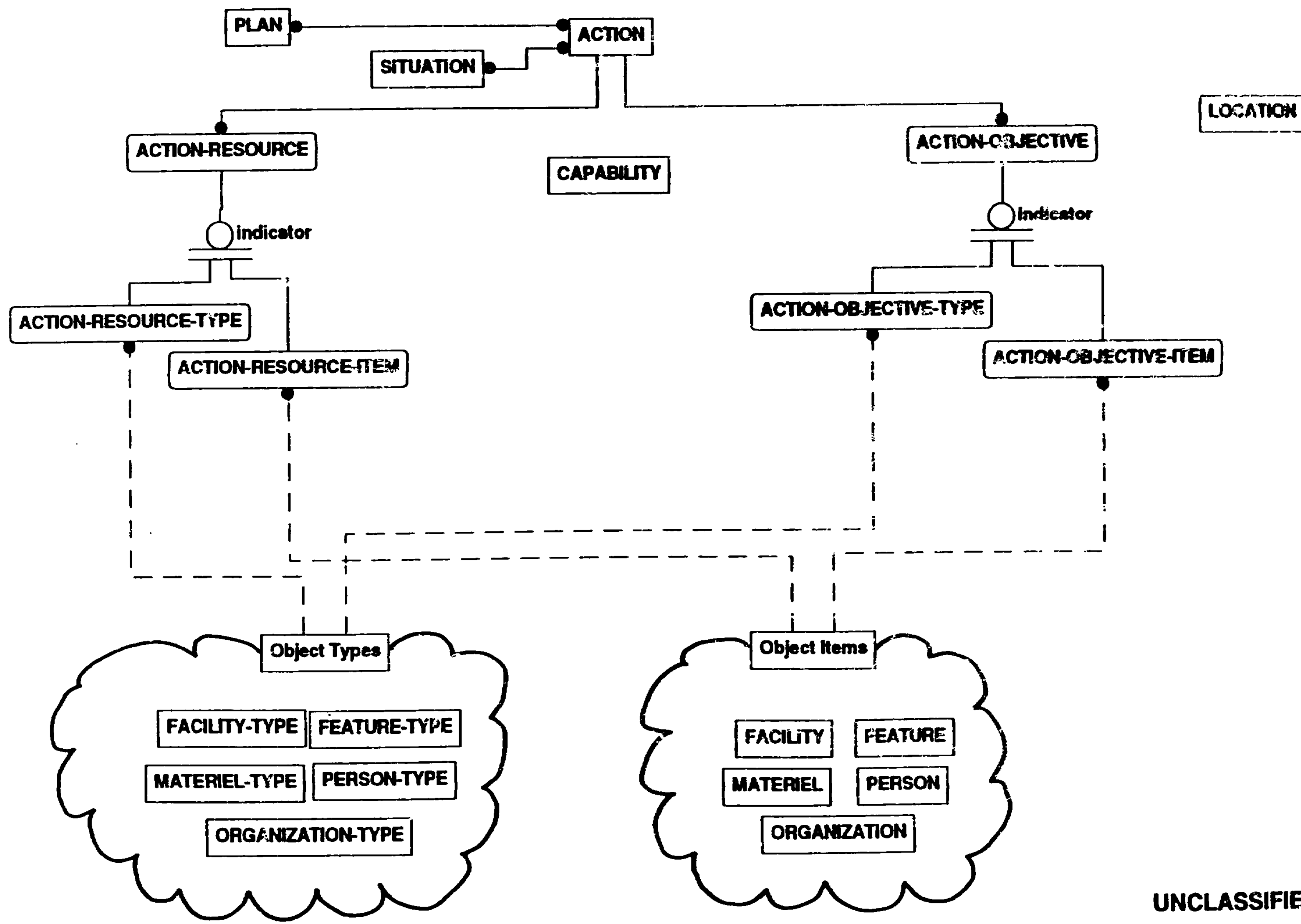
2. C2 CORE–RESOURCE AND OBJECTIVE



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3. C2 CORE–LOCATION AND TARGET

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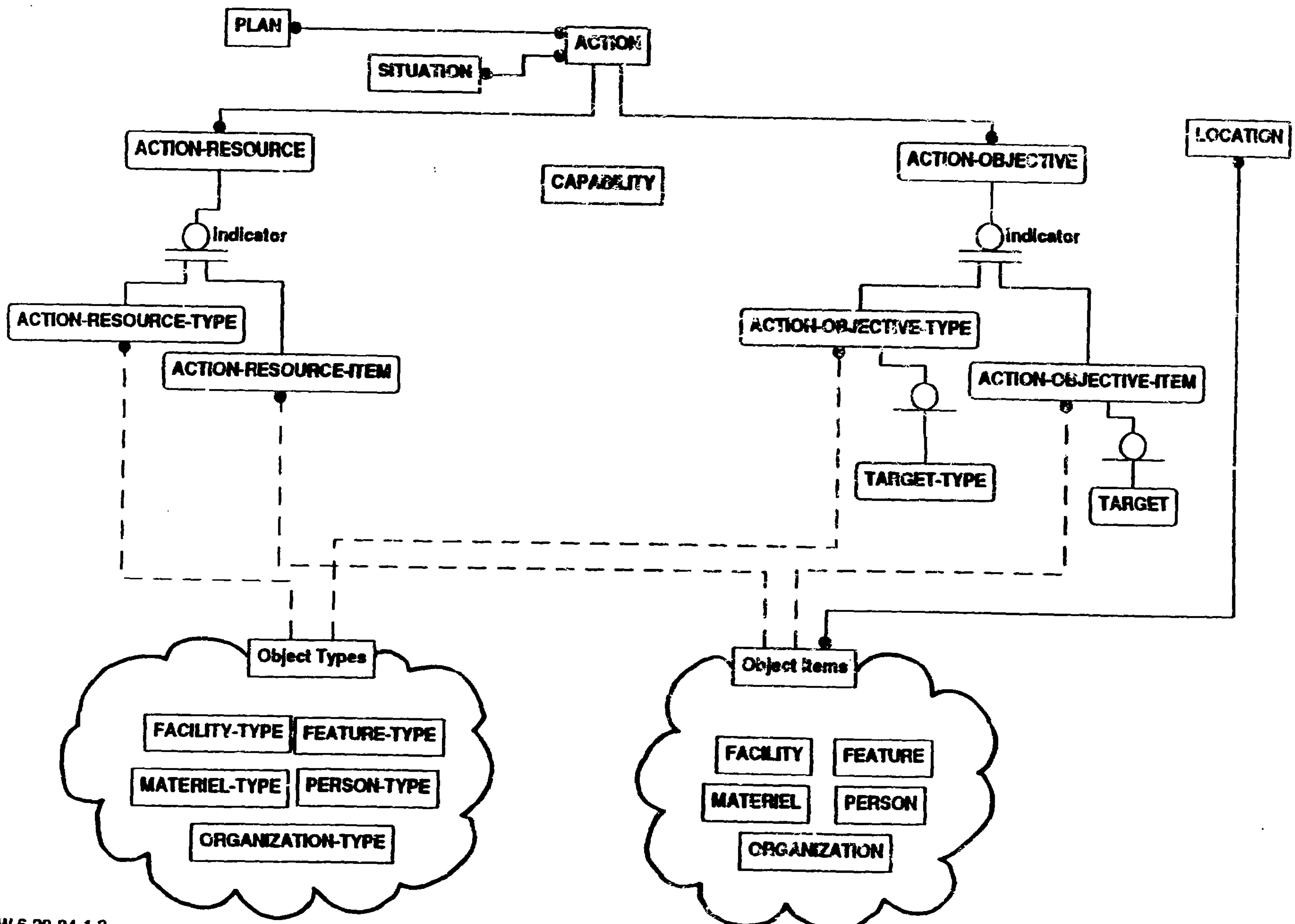
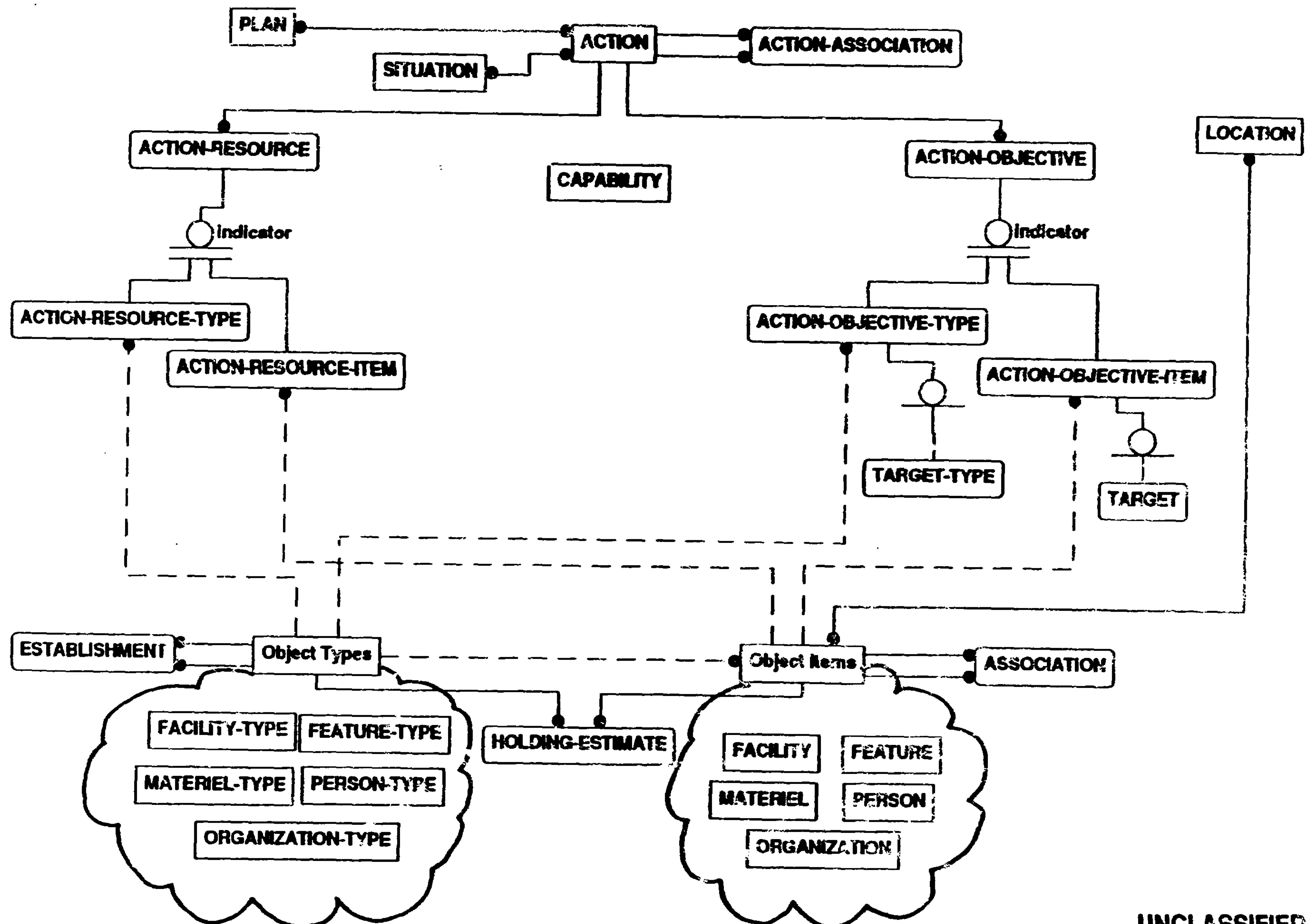
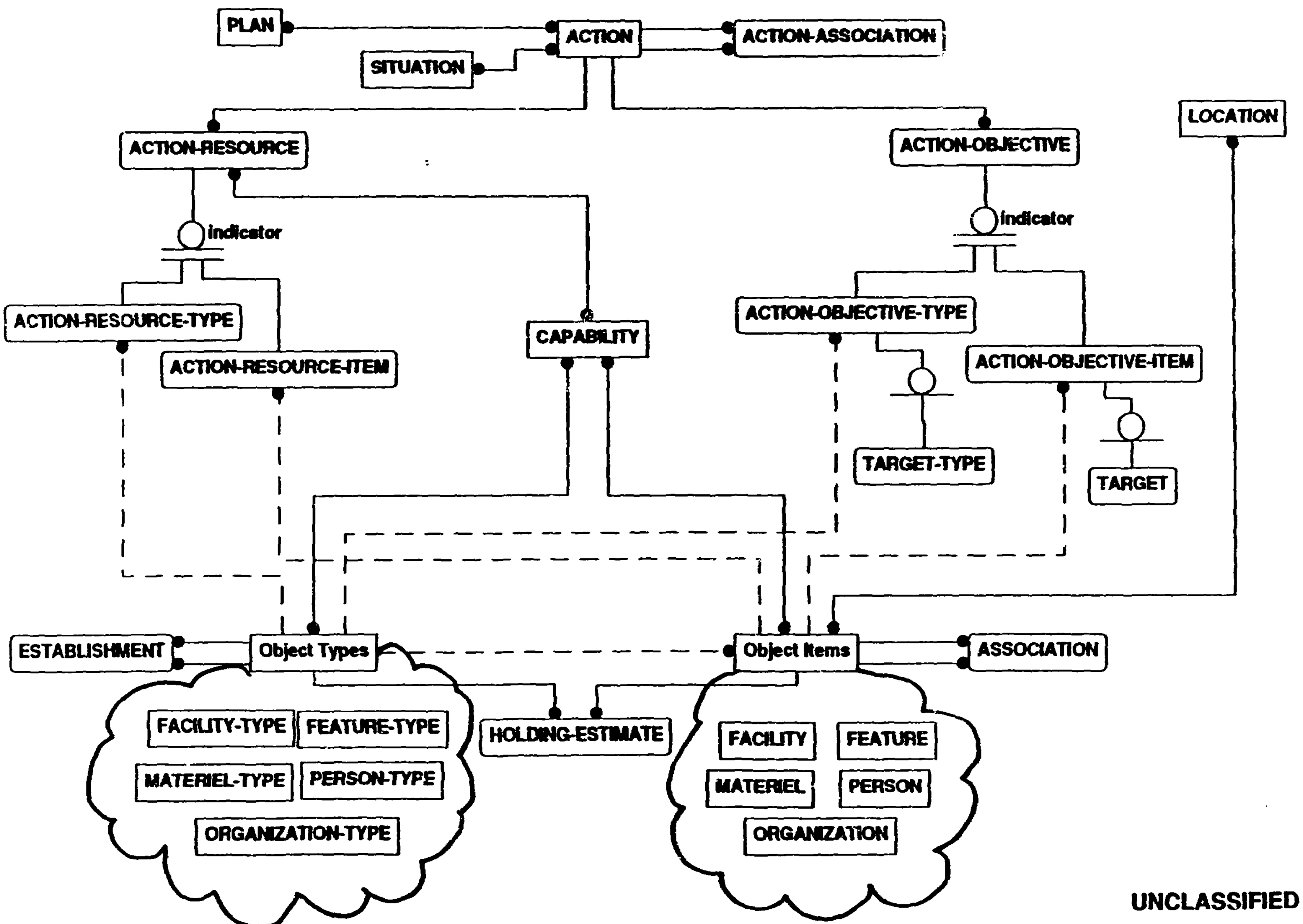


DRAFT

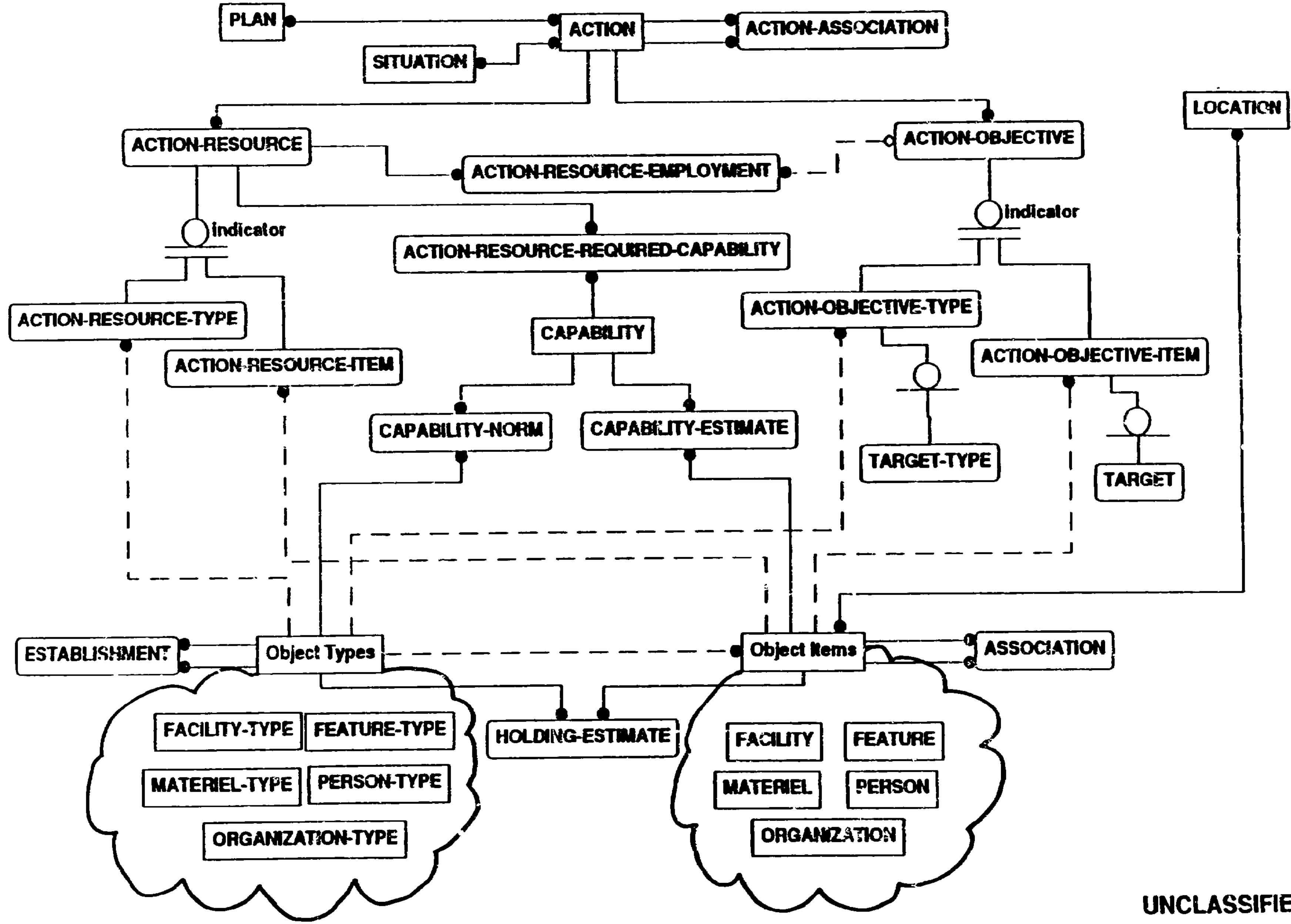
4. C2 CORE–ASSOCIATIONS



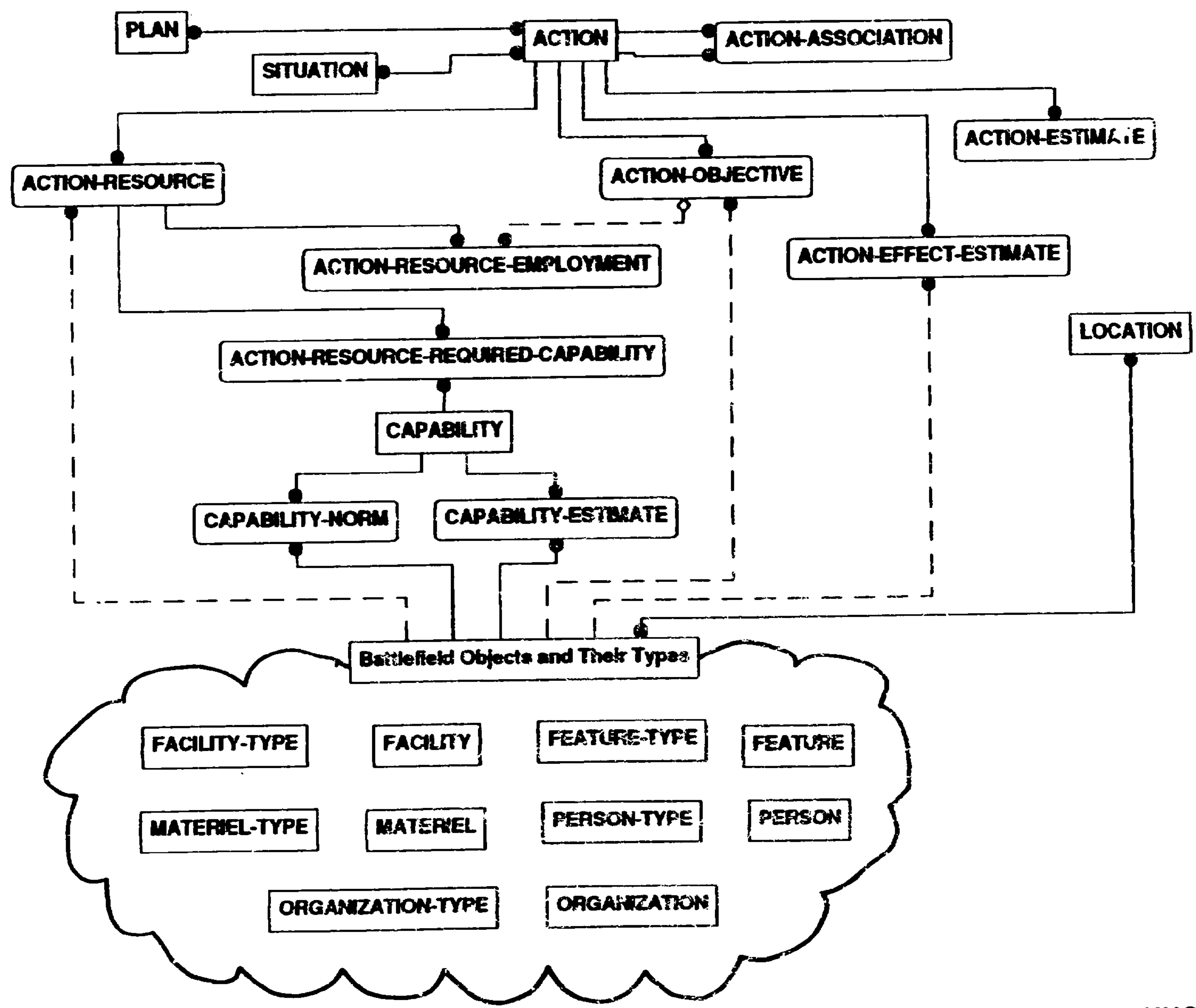
5. C2 CORE–CAPABILITY



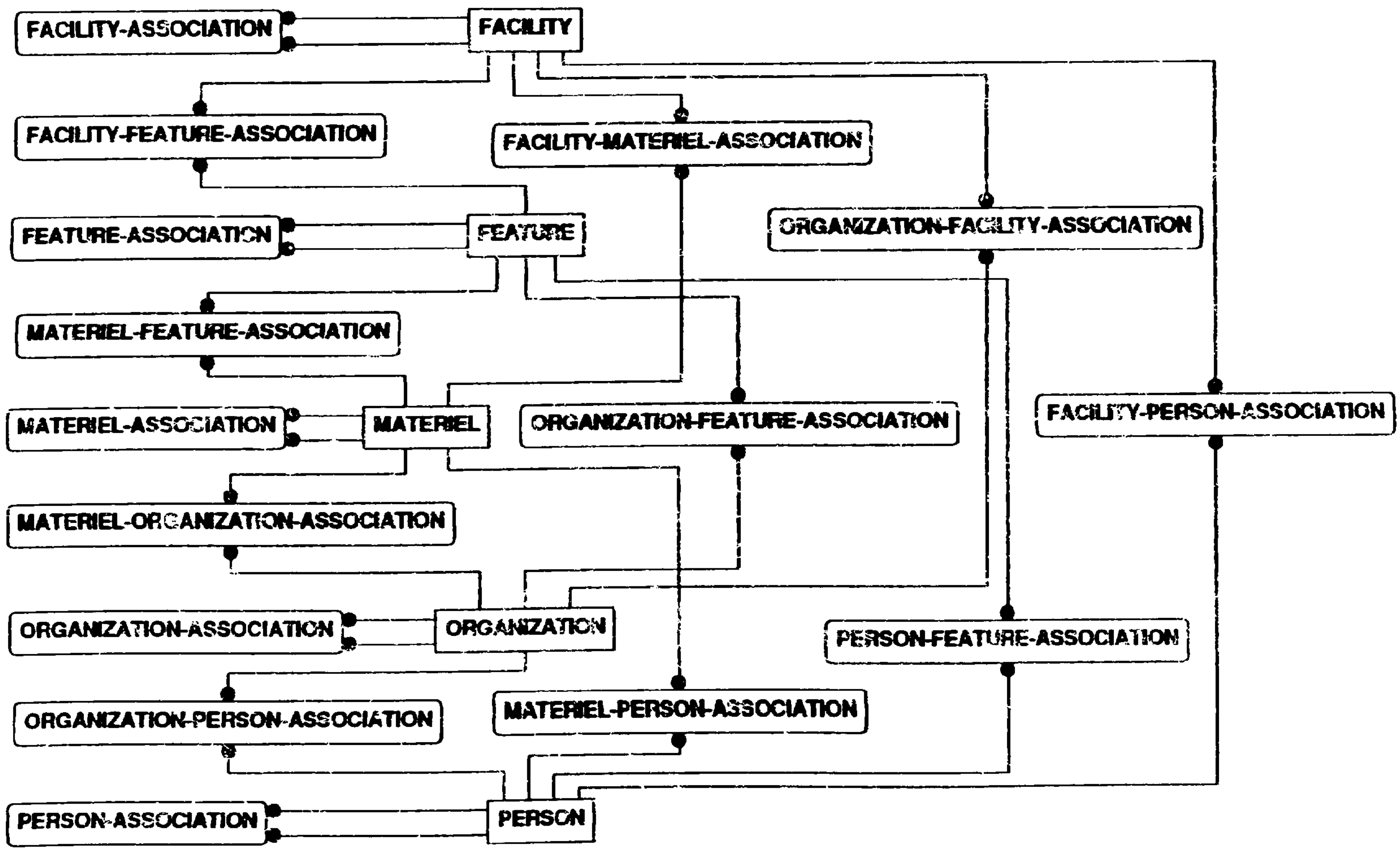
6. C2 CORE–EMPLOYMENT AND CAPABILITY DETAIL



7. C2 CORE–ACTION ESTIMATES



8. C2 CORE–ASSOCIATION EXAMPLE VIEW



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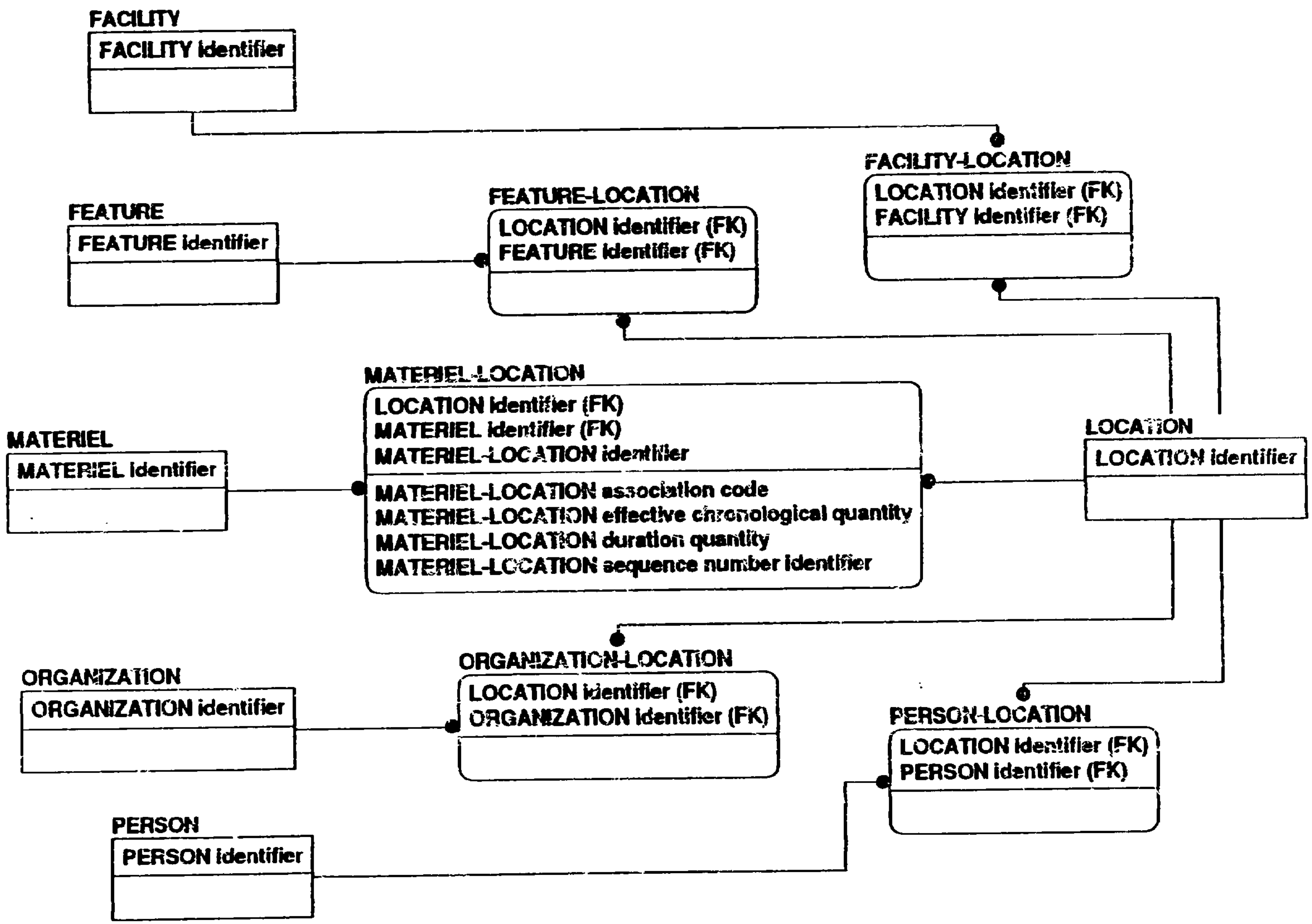
9. C2 CORE–LOCSATION ASSOCIATION VIEW



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Challenges

COORDINATION OF C3I MODELLING EFFORTS

- BRINGING TOGETHER M&S WITH C2 AND INTELLIGENCE INTIATIVES
- INTEGRATING COMMUNICATIONS-ELECTRONICS AND ENVIRONMENTAL DATA MODELLING
- EXPANDING THE C2 CORE AS NEW CORE REQUIREMENTS EMERGE
- INTEGRATING ENTIRE C2 FUNCTIONAL AREA INTO ONE C2 DATA MODEL
- SUPPORTING DEVELOPMENT OF GCCS DATA MODEL
- ACCELERATING MODEL INTEGRATION
- ACCELERATING DATA STANDARDIZATION
- MAINTAINING FOCUS ON DEVELOPERS AND USERS

ADDITIONAL INFO

FIA DATA MODELS

- CHARACTERIZE INFORMATION COVERED BY FUNCTIONAL INTEROPERABILITY ARCHITECTURES DEVELOPED BY JIEO AND VALIDATED BY JOINT STAFF
  - Fire Support
  - JTF Operations Control
  - Air Defense and Airspace Control
  - Land Combat Operations
  - Intelligence
  - Air Operations
  - Special Operations
  - Combat Service Support
  - Maritime Operations
- FOCUS ON JOINT AND COMBINED INFORMATION EXCHANGES BASED ON NEED LINES IDENTIFIED IN THE FIAs

C2 SUBFUNCTIONAL DATA MODELLING

- PROGRESS IS BEING MADE
  - Fire Support: Review completed Aug 94; data std. begun
  - JTF Operations Control: GCCS data modelling just begun
  - Air Defense and Airspace Control: Underway
  - Land Combat Operations: ATCCS prototyping effort underway
  - Intelligence: C2 Core is being promoted; other efforts underway
  - Air Operations: Initial data model (air tasking order) done
  - Special Operations: Initial data model done
  - Combat Service Support: Integration of JOPES LDM and C2 Core
  - Maritime Operations: Initial NWTDB data model (draft)

- MANY OF THESE ARE NOW BASED ON C2 CORE (Fire Support, GCCS, Air Defense, ATCCS, Intel, NWTDB); OTHERS SOON TO COME

- WORK ON LOCATION, FEATURE, METOC, AND COMM-ELECTRONICS IS UNDERWAY; MANY EFFORTS ARE FOCUSED ON C2 CORE

STANDARDS FOR DOCUMENTATION AND ANALYSIS

- DOCUMENTATION
  - High-level IDEF0 activity model with diagram and definitions
  - IDEF1X diagram
  - Attribute and entity defintions (with indications of sources)
  - Relationship table ("business rules")
  - Example domains with cross references to current standards
  - Description of methodology*

- ANALYSES
  - Entity-by-entity description with instance tables
  - Relation of activity model and data model
  - Specification of common C2 products in terms of data model with instance tables
  - Element-by-element analysis of degree to which each element of data in current use is supported by the data model
    - Interoperability standards (multinational and joint)
    - Service data requirements
    - System specifications
  - Integration to DoD Enterprise Model
  - Relation to DoD policy, guidelines, and architectures (e.g., FIAs)

Challenges

CAUTION ON APPLICABILITY

- DATA MODELS TAKE TIME TO DEVELOP, VALIDATE, AND INTEGRATE
- HEAVY INVESTMENT IN EXISTING MESSAGES WILL REQUIRE TIME AND RESOURCES TO EFFECT A TRANSITION
  - Transition strategy needs to be carefully developed with clear priorities
  - Centralized leadership is needed to focus DoD activities
- MAJOR IMPACT IS LONG-TERM, WITH POTENTIAL MID-TERM BENEFITS IN SELECTED AREAS

CANDIDATE ELEMENTS OF A C2 DATA MIGRATION STRATEGY

Element	Status/Product	Time Frame	Relation of Product to GCCS and Integrated C2 Data Model
DoD Enterprise Model	Revision released	Feb 94	Basis for integrating C2 with other DoD functional areas (a single DoD data model is needed to ensure consistent data elements)
DoD Data Model	Ongoing; quarterly revision planned for mid-July 1994	Ongoing	Records structure of approved entities and attributes; basis for DoD model integration
GCCS Data Architecture Report	Draft Version 1.2 completed by DAPMO	15 Feb 93	TBD: Identifies clusters that can be used to prioritize work
GCCS Data Migration Strategy and Standardization Plan	Draft completed by DAPMO	28 Feb 94	TBD
GCCS Data Modelling	New tasking for IDA directed by J6V	Initial Report Dec 93; drafts bimonthly	Expanding C2 Core Data Model to develop GCCS Data Model, incorporating other data modelling products where applicable; integrated to the DoD Data Model
Starter Set of Data Elements)	Version 0.1 completed by JIEO/CFS	1 Dec 93	Candidate interim data elements (not model based)
C2 Core Data Model	Completed by DISA at direction of MCEB; available for use; revision planned Jun 94	1 Sep 93	Candidate starting point for GCCS Data Model and for integrating all C2 data models
Global C2 Process Improvement Study	Final Report by Joint Staff and Services team	15 Jan 93	Identifying information exchange requirements; prioritization
Joint Operation Planning Process Improvement Conference	Final Draft Report	14 Jan 93	Identifying information exchange requirements; prioritization
JOPES Logical Data Model	Contains IDEF0 Views of JOPES data; technical integration to C2 Core and DoD Data Model evaluated by DAPMO	30 Sep 93	Expanding C2 Core; early work on technical integration focuses on preserving existing LDM structure and introducing non-identifying relationships to entities in C2 Core
Scheduling and Movement (S&M) Physical View of JOPES data	IDEF1X specification of a physical schema based on JOPES LDM for mid-term GCCS capability	30 Sep 93	Expanding C2 Core
USPACOM Crisis Action Planning and Execution Preliminary Economic Analysis	Preliminary Draft (data model in Annex F uses Generic Hub/C2 Core)	30 Sep 93	Expanding C2 Core; identifying information exchange requirements

CANDIDATE ELEMENTS OF A C2 DATA MIGRATION STRATEGY (CONT'D)

Fire Support Data Model	Completed by IDA for JIEO/CFS/C3I Supp Div	Aug 93	Expanding C2 Core for fire support C2 subfunctional area
Air Operations Data Model	Draft focused on ATO messages completed by multi-Service group led by JIEO	3 Sep 93	Expanding C2 Core for ATO portion of air operations C2 subfunctional area
SOCOM Data Model	Draft focused on readiness completed by SOCOM	20 Aug 93	Expanding C2 Core
Joint Meteorology/Oceanography (METOC) Process Modelling	Final Report contains top-level producer view of METOC products	19 Apr 94	TBD
METOC Conceptual Data Model	Review draft; integrated to C2 Core	22 Dec 93	Expanding C2 Core (e.g., MET-FEATURE and other GEOPHYSICAL-FEATUREs)
Naval Warfare Tactical Data Base (data specification)	Standard by N62 provides IDEF0 views and early version of integrated data model; Version 2 released June 1992 addresses OSS and NTCS-A	Ongoing	Expanding C2 Core for maritime operations C2 subfunctional area
Army Tactical Command and Control System (ATCCS) data modelling and prototype system	Implemented C2 Core with displays for force level control	Ongoing	Expanding C2 Core for land combat operations C2 subfunctional area
Army Tactical Command and Control Information System (ATCCIS) data modelling for Battlefield Generic Hub and extensions for fire support, communications-electronics, personnel, and barriers-engineering	Generic Hub (April 1993) and Generic Hub Level 2 (planned for July/August 1994); multinational (10 NATO nations);	Ongoing	Generic Hub was original basis for defining C2 Core; work during last 13 months can be used to expand the C2 Core; GCCS model could be used to form US positions for ATCCIS
CIM Modeling Study of DoD Management and Use of the Electromagnetic Spectrum	Interim Report by the J208Z Permanent Working Group	Aug 93	TBD
Digital Geographic Information Exchange Standard (DIGEST) Specification	Multinational activity; DMA has US lead; Edition 1.2	Jan 94	Expanding concept of feature

IEEE 1320.2
IDEF1X Working Group

Update Briefing

Pete Valentine

What is IEEE 1320.2 ?

- Working Group attempting to define the next generation of IDEF1X language
- Formed from the group which wrote the current FIPS 184
- Mix of Industry and Government representatives

Request for Changes (RFC)

- Make the Formalization more accessible
  - Annotated versions of the Formalization have been developed and are being reviewed
- Add Constraint Language and required support
  - Add Support for Entity Identity
  - Make Primary & Foreign Keys Optional
  - Add Names at either or both ends of a Relationship
  - Subset of Language sufficient to express FK by 1X-95
  - Incremental evolution into full ADT and method support

Request for Changes (RFC)

- Allow Discriminator from ancestor
  - Allow use of any attribute in view as discriminator
- Support Multiple Inheritance
  - Under Discussion
- Re-examine Alias support
  - A meta-model issue that is being researched
- Specify the Transform Model
  - Under discussion

Request for Changes (RFC)

- Interchange Format
  - IDL PAR has been withdrawn
  - CDIF & other techniques are being discussed
- Dictionary Hierarchy*
  - Item requires restatement
- Usage Guidelines for Upper ZF Rows*
  - Item requires definition
- Full Method Support
  - Includes support for ADT, methods with arguments and specification language

Other Efforts

- Conformance Guidelines
  - NIST - Bruce Rosen
  - Less formal than conformance tests
- WG Members currently evaluating RCL by creating examples in each of their areas of expertise

Issues

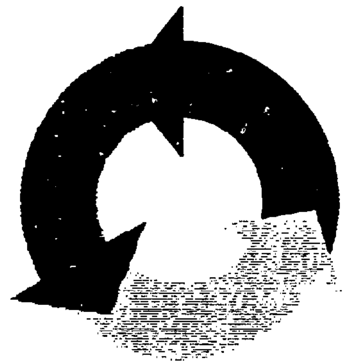
- Lack of vendor participation
- Funding for development of language components

Next Working Group Meeting

Place:	NIST, Building 225, Room B157
	Gaithersburg, MD
Time:	August 7-9, 1994
	08:30pm - 5:00pm
POC:	Mary Laamanen
	301-975-3260

NOTE: Attendees are expected to WORK!

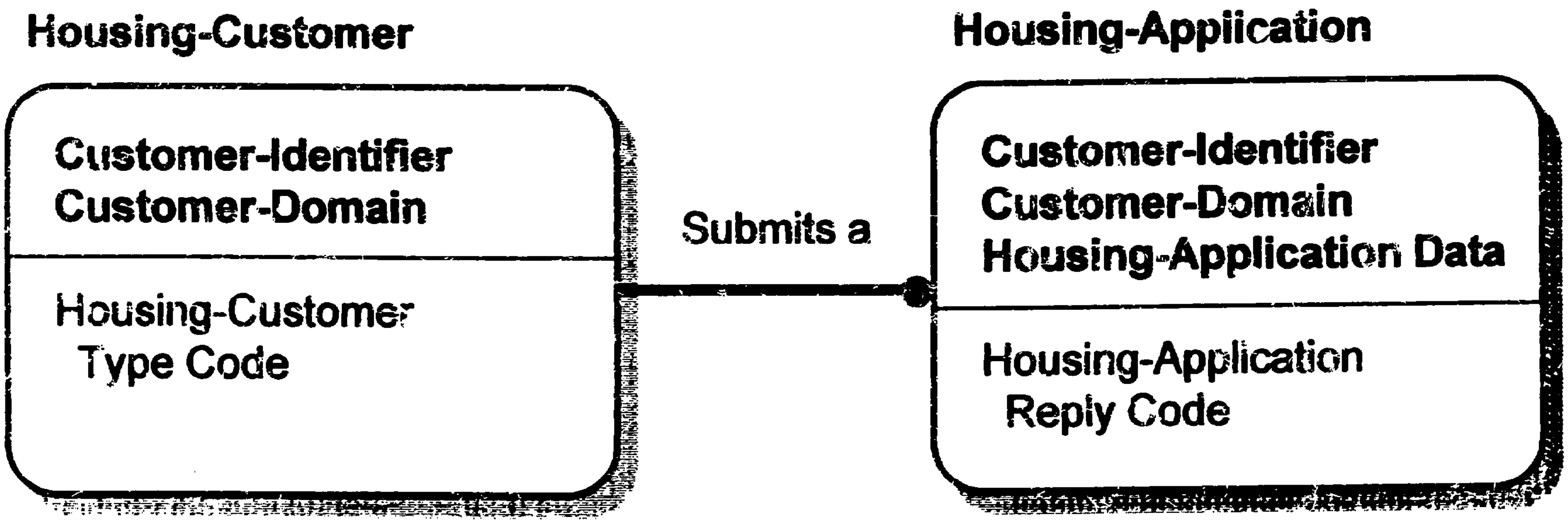
M 22



Data Management Directorate

The IDEF1X Experience

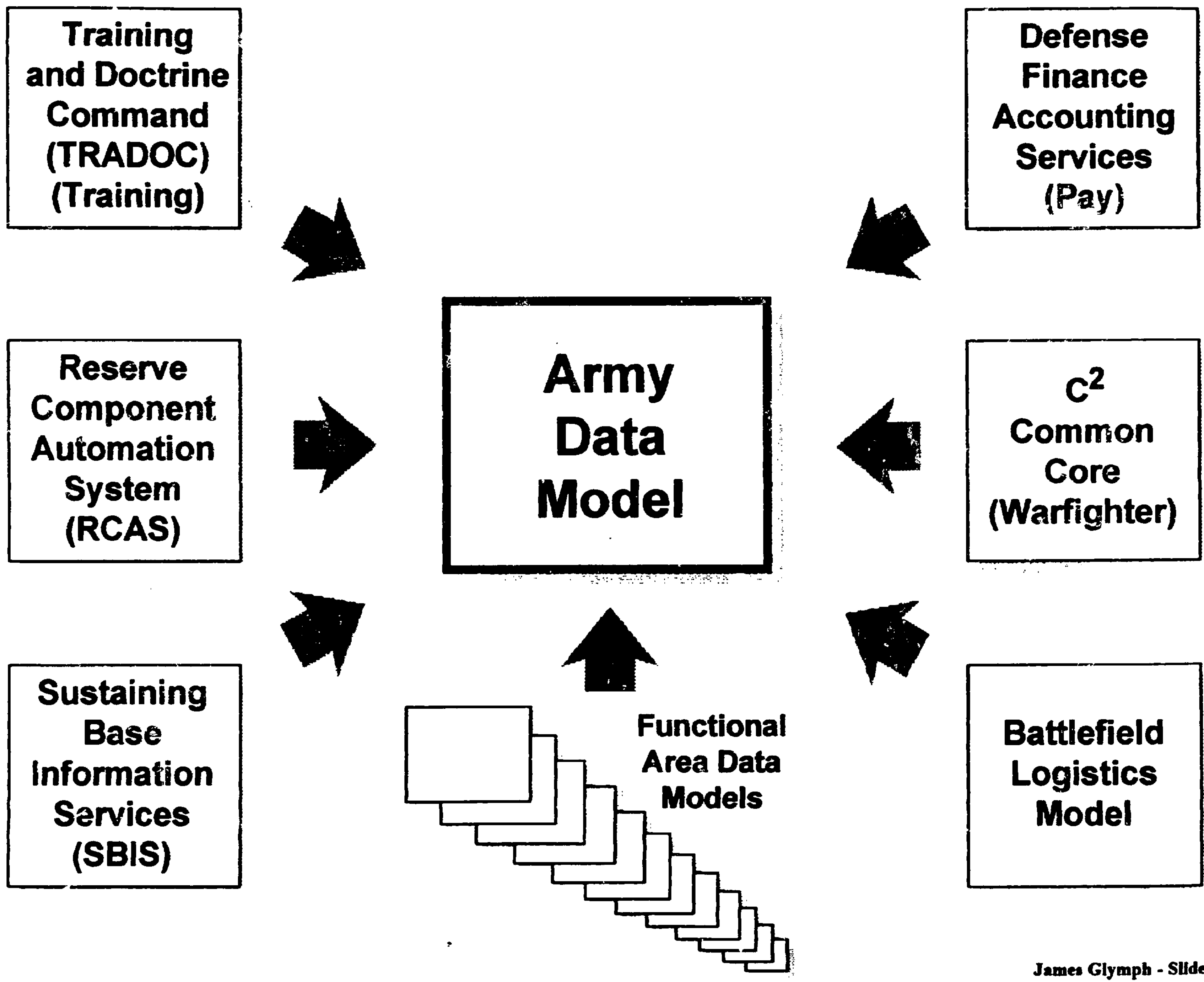
James L Glymph


Housing-Customer
Customer-Identifier
Customer-Domain
Housing-Customer
Type Code
Submits a
Housing-Application
Customer-Identifier
Customer-Domain
Housing-Application Data
Housing-Application
Reply Code

Experience Base

Oct 90 → Present

- Twenty Army Functional Area Models
- Army Data Model
- Six Sustaining Base Information Services (SBIS) Application Models and Integrated View
- Rework of Battlefield Logistics Model



James Glymph - Slide 5

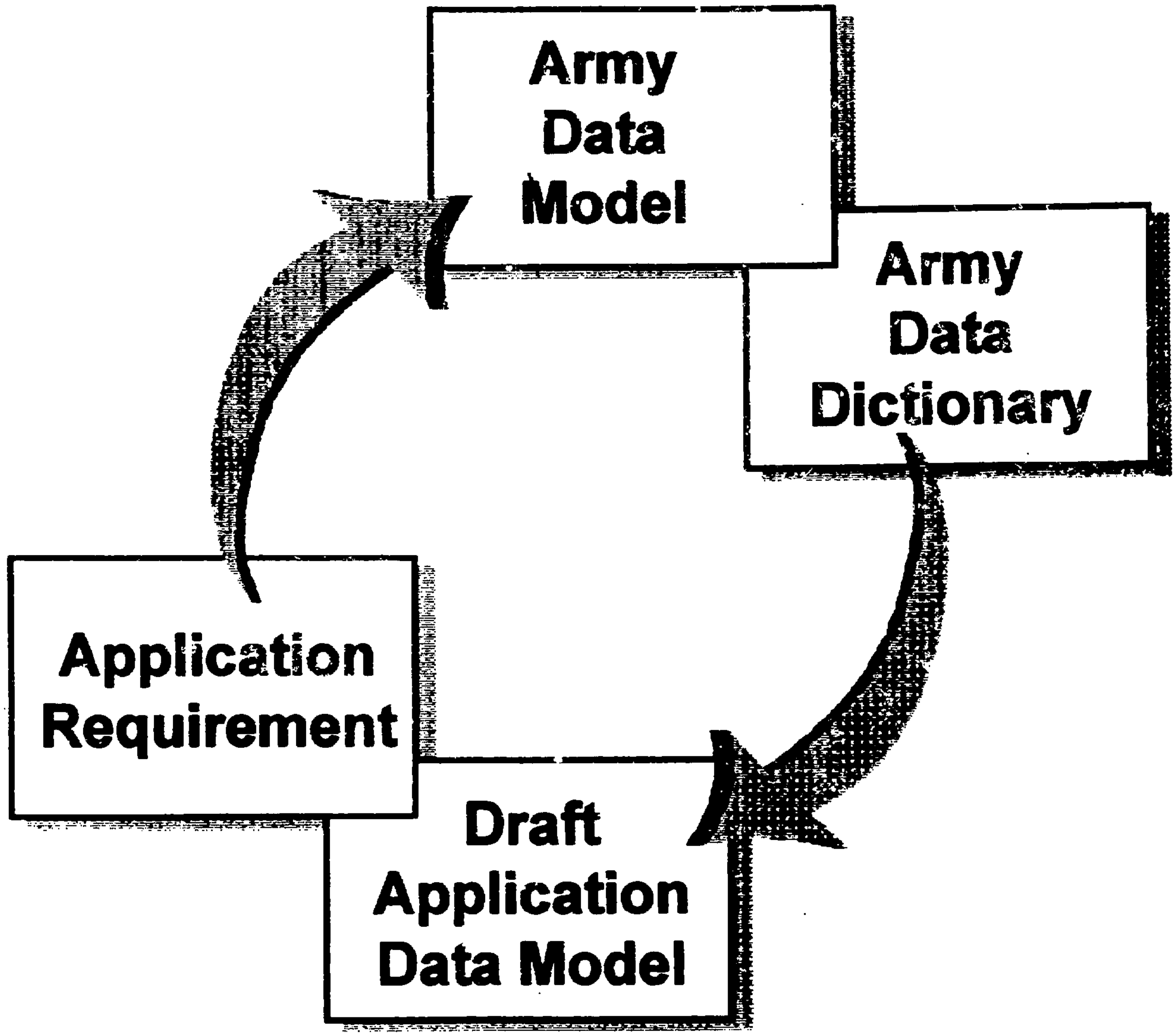
"Getting to 1X"

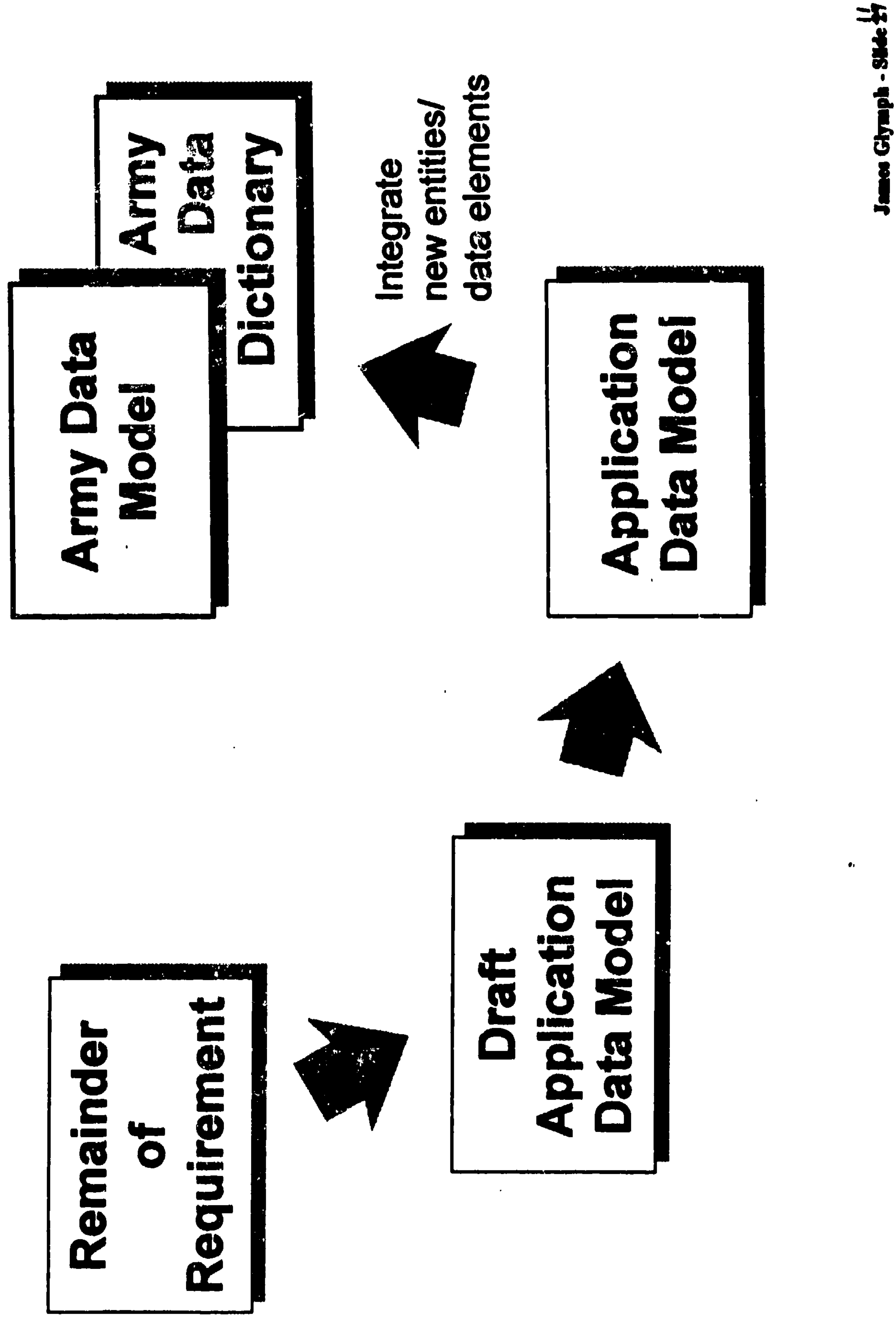
IDEF0 → 1X

Functional Description → 1X

Facilitated Workshop → 1X

Database → 1X


Army
Data
Model
Army
Data
Dictionary
Draft
Application
Data Model
Application
Requirement


Remainder
of
Requirement
Draft
Application
Data Model
Application
Data Model
Army Data
Model
Army
Data
Dictionary
Integrate
new entities/
data elements
James Glymph - Slide 27

Training Application Model

20% Reuse of Standard Data Elements

40% Reuse of Entities

Structured Requirements Analysis Planning (STRAP)

- Executive Summary
- Introduction
- Project Definition and Approach
- Activity Models
- Data Model
- Lessons Learned
- Improvement Opportunities and Follow-on Actions
- Glossary

Lessons Learned

- Facilitator is the Key
- Need the Right Functionals
  - Customer vs User
- Functionals Need Minimum IDEF Training
- Do Standards with Model
- Reuse

26 M

Army M & S Master Plan

Presented By

Lana Eubanks McGlynn

To The

DMSO I/DB Task Group

12 July 1994

Army M & S Master Plan

Purpose

- To promote the adoption of standards and common tools and processes in building and populating models and simulations for use in all applications throughout the Army.

Army M & S Master Plan

Status

- Required by DoDD 5000.59
- Published 4 May 94
- Scheduled For Review 1st Qtr FY 95

Army M & S Master Plan

Organization

- Chapter I - Introduction
- Chapter II - M & S Environment
- Chapter III - Standards Development
- Chapter IV - Investment Strategy
- Chapter V - Plan Implementation
- Appendix A - Glossary
- Appendix B - References
- Appendix C - Roles and Missions
- Appendix D - AMIP/DMSO Format

Army M & S Master Plan

Chapter I - Introduction

- Purpose
- Background
  - *Historical Applications*
  - *Distributed Simulation*
  - *Cataloging*

Army M & S Master Plan

Chapter II - M & S Environment

- Common Use Models
- Modeling Standards
- Reuse of Functionality
- Data Utilization
- Communications Standards
- State-of-the-Art Research

Army M & S Master Plan

Chapter III - Standards Development

- Development Process
- Categories
- Category Coordinators
- State of Standards by Category

Army M & S Master Plan

Standards Development *Process*

- *Task 1:* Establish Team Arrangements
- *Task 1a:* Perform Domain Analysis
- *Task 2:* Define Standards/Svcs Rqrd
- *Task 3:* Develop Tech/Proc Standards
- *Task 4:* Achieve Comm Consensus
- *Task 5:* Build Repositories
- *Task 6:* Educate & Assist Modelers/Users

Army M & S Master Plan

Standards Categories

- *VV&A Methodologies*
- *Data Standards*
- *System Services*
- *Environmental Representations*
    - Terrain (Static and Dynamic)
    - Dynamic Environment

Army M & S Master Plan

Standards Categories (Cont.)

- *Battlefield Algorithms*
  - Acquire
  - Move
  - Attrit
  - Reasoning
  - Arm, Fix, Supply, Service
  - Communicate

- *Operations Other Than War*

Army M & S Master Plan

Standards Categories (Cont.)

- *Strategic Activities*
  - *Mobilization*
  - *Deployment/redeployment*
  - *Warfighting*
  - *Sustainment*
- *Cost Representation*
- *Distributed Simulation Standards*
- *Computer Generated Forces*
- *User Interfaces*

Army M & S Master Plan

Standards Category Coordinators

- VV&A - TRADOC-TRAC
- Data - TRADOC-TRAC/AMC-AMSAA
- Environmental Rep - COE-TEC/ARL
- Cost Representation - ASA (FM)-CEAC
- DIS Standards - AMC-STRICOM
- Comp Gen Forces - TRADOC-TRAC
- User Interfaces - AMC-STRICOM

Army M & S Master Plan

Standards Category Coordinators

- Strategic Activities
  - Mobilization - CAA/AWC/LEA
  - Deployment/Redeployment - CAA/AWC/LEA
  - Warfighting - CAA/AWC
  - Sustainment - CAA/AWC/LEA
- Operations Other Than War - AWC

Army M & S Master Plan

Standards Category Coordinators

- Battlefield Algorithms -
  - Acquire - AMC-AMSAA,CECOM/
    TRADOC-TRAC WSMR
  - Move - COE-WES/
    TRADOC-Avation Ctr
  - Attrit - AMC-AMSAA/
    TRADOC-FA School
  - Arm, Fix, Supply,Service- LEA/
    TRADOC-CASCOM
  - Communicate - AMC-CECOM/
    TRADOC Signal School
  - Reasoning-TRADOC-BCBL,NSC/ODCSINT

Army M & S Master Plan

Crosswalk

DMSO TWG	***Corresponding Army Standards Category***
Environment	Environment
Comp Gen Forces	Comp Gen Forces
Human Systems Int	User Interfaces
Interop w/C3I Sys	Communications
V,V & A	V,V & A
Architecture	System Services
Networks	Distributed Sim Stds

Army M & S Master Plan

State of Standards by Category

- *Classifications* *(Overall Health)*
  - *Green:* *Standards development on track*
  - *Amber:* *Standards understood, undeveloped*
  - *Red:* *Standards undefined*
- *Condition by Task* *(Current Situation)*
  - *To be demonstrated by Standards Category Coordinators*

Army M & S Master Plan

Investment Strategy

- *Base investment decisions on*
  - *Overall "health" of Category*
  - *Current Funding status*
  - *AMIP availability*
  - *DMSO strategy*

- *SIMTECH - Continues Separately*

Army M & S Master Plan

Chapter V - Plan Implementation

- Modernization Plan
  - Coordinators Annual Report
  - AMSEC Deliberations
  - DMSO Project Deliberations
  - Publish 1 Oct annually

- Revision of Master Plan
  - Three Year Cycle
  - One year Initially

Army M & S Master Plan

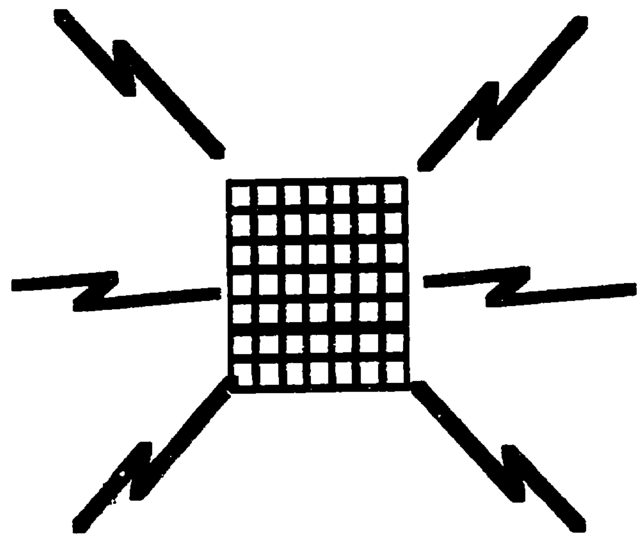
Appendices

- A: Glossary
- B: References
- C: Roles and Missions of Army Modelers and Users
- D: AMIP/DMSO Nomination Format
  Standards Category Project Nomination Format

M 23

Air Force Data Administration
M&S Activities

HQ USAF, DCS/Command, Control, Communications, and Computers



HQ USAF/XOMT
Lt Col Cheryl Balombini

HQ USAF/SCTA
Maj Roger VanEpps

Overview

HQ USAF, DCS/Command, Control, Communications, and Computers

- Program Structure
- Air Force Structure
- Data Administration Objectives
- M&S Vision
- Key Steps
- Current Status
- Summary

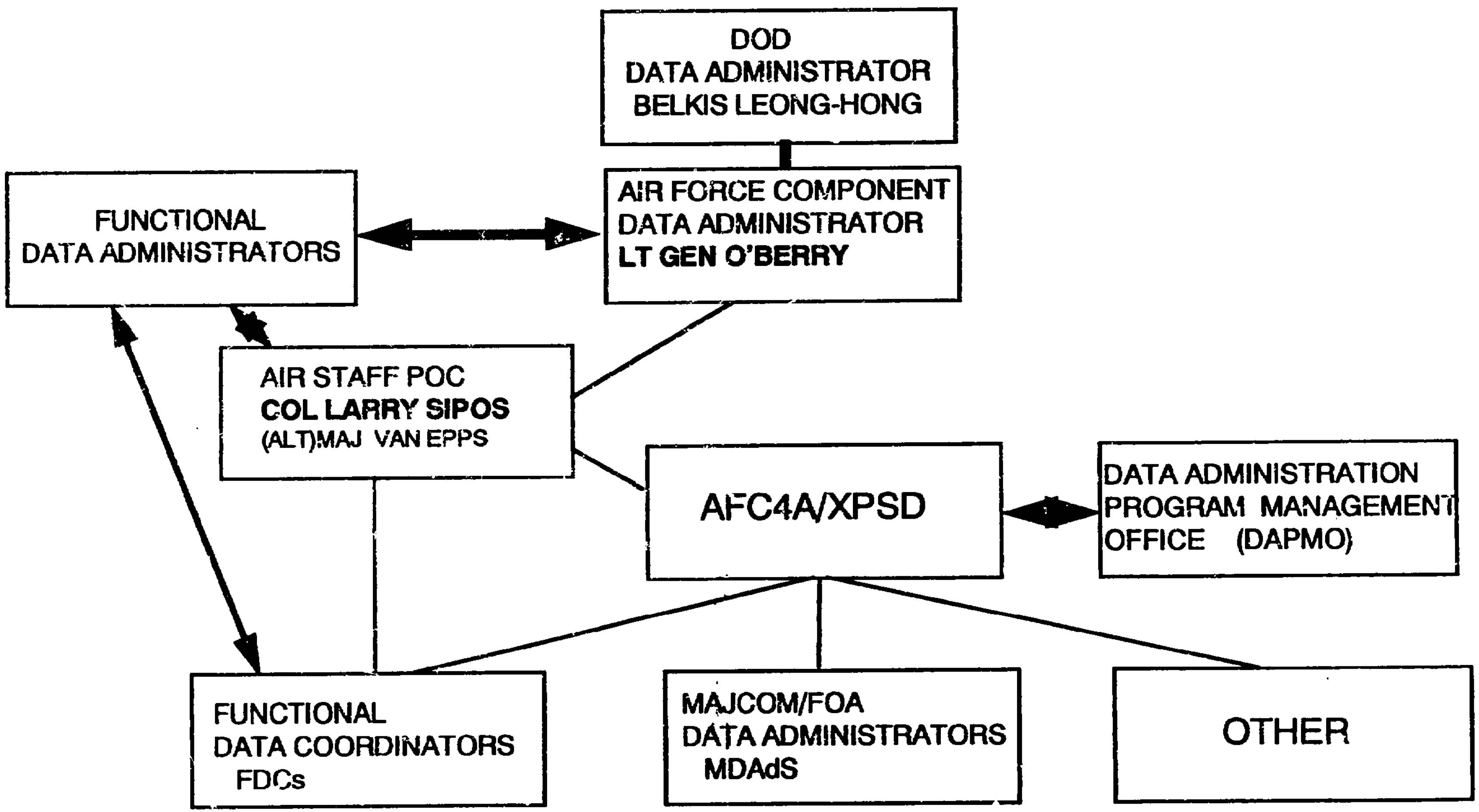
Data Administration Program Structure

HQ USAF, DCS/Command, Control, Communications, and Computers

- DOD Program
  - Driven by OSD Functionals
  - Supported by Components
  - Technically administered by DISA
- Contents
  - Data Element Standardization
  - Data Quality
  - Data Security
  - Data Base Administration

Organizational Structure

HQ USAF, DCS/Command, Control, Communications, and Computers



Data Administration Objectives

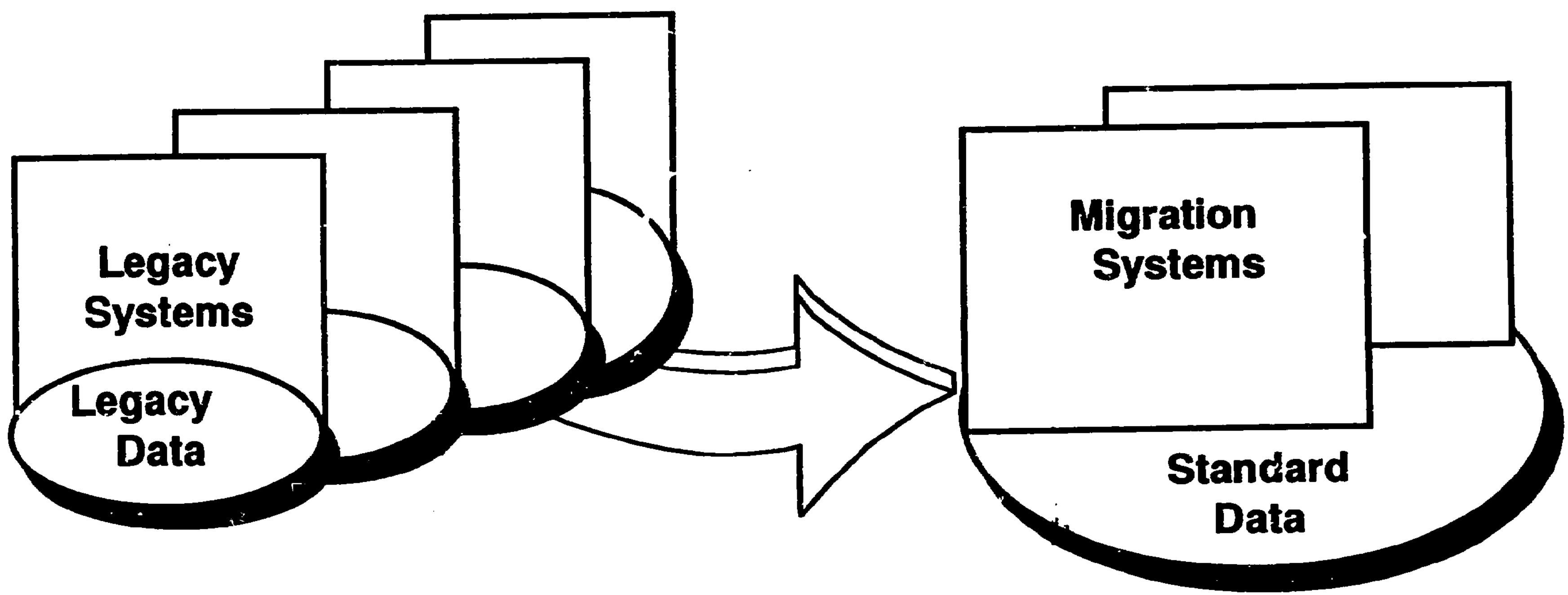
HQ USAF, DCS/Command, Control, Communications, and Computers

- Select a single name, definition and description for a datum
- Agree to across DOD
- Provide common medium for communication

Complements Migration

HQ USAF, DCS/Command, Control, Communications, and Computers

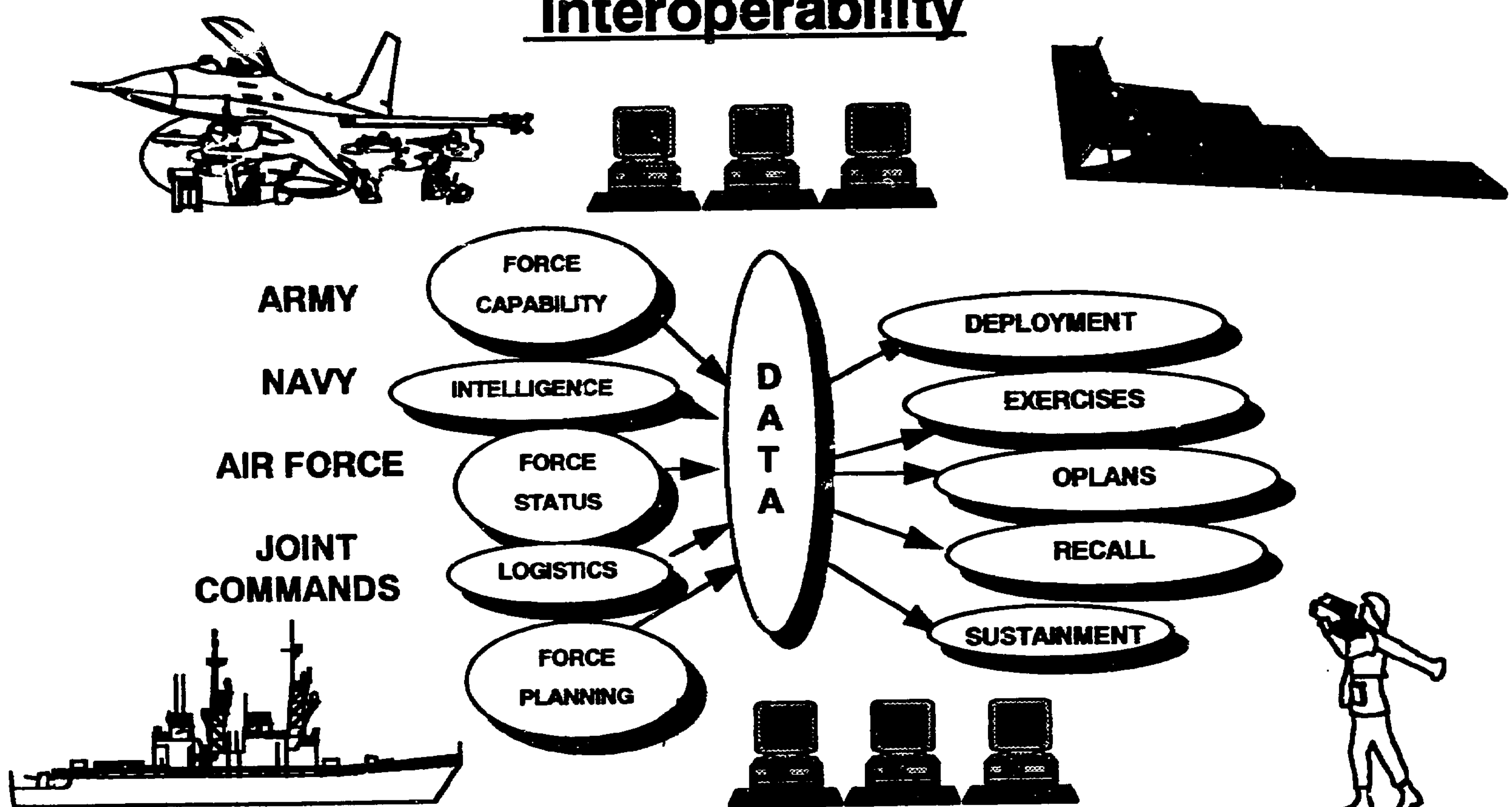
- Evolutionary Path Toward Common Systems and *Standard Data*



Why is it Important

HQ USAF, DCS/Command, Control, Communications, and Computers

Interoperability



AF/XOM

Modeling & Simulation Vision

- Provide Guidance to AF M&S Community
- Oversee Development Activities
- Foster Implementation of Data Standards for M&S activities

AF/XOM

XOM Functions

- Provide AF MS&A Leadership and Policy
- Warfighter Support To:
  - Doctrine, Strategy, Training, Wargaming, Exercises
- Analysis Support To:
  - Requirements, Force Planning, Cost & Operational Effectiveness (COEA), Acquisition, Test & Evaluation
- Technical Support For:
  - Standards, Verification, Validation & Accreditation, Technology Assessment
- Perform Analysis To Support USAF

AF/XOM

Key Implementation Steps

- Develop Comprehensive M&S Index
- Assess Development Initiatives
- Employ Standardized Data in Model Development
- Continue to Evolve Legacy Systems

AF/XOM

Joint Simulation System

- Joint Framework For Next Generation M&S Environment
  - Initial Focus To Replace The ALSP Confederation Of Models
- Initiative Will Eliminate:
  - Duplication
  - Interface Difficulties
  - Data Sharing Problems
  - Over Investment Of Critical M&S Dollars

AF/XOM

Current Status

- M&S is the Focus of XOM
- Data Collection is Underway
- Data Administration is in its Infancy
  - Facilitate application within development
  - Pursue development of standards where none exist
  - Work closely with DOD community

AF/XOM

Beliefs About The Future

- Simulation Can lead <u>directly</u> To Improved Readiness For Aerospace Forces
  - Training And Education
  - Combat Operations
- Simulation Provides The Potential For Significant Improvements To The Acquisition Process
  - Improved Quality
  - Reduced Costs
- Simulation's Promise Will Be Lost Without Warfighter Involvement And Direction

AF/XOM

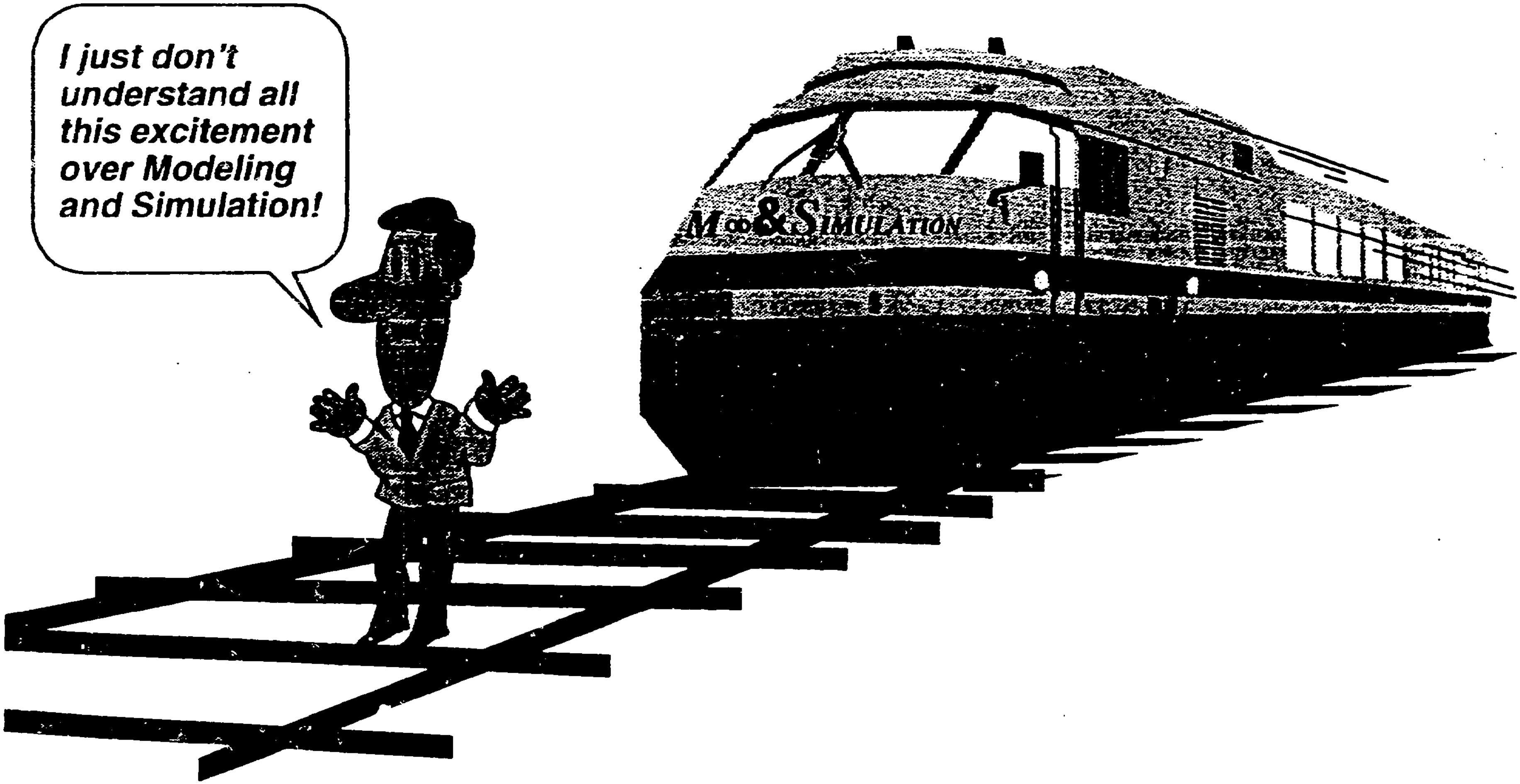
Summary

- Resources are in place
- Process is evolving
- Future is focused on the steps of implementation

NAVY AND MARINE
MODELING AND SIMULATION

DEPARTMENT OF NAVY M&S MANAGEMENT

Dean Free



UNITED STATES NAVY
MODELING AND SIMULATION

SASC OBSERVATION

- "THE COMMITTEE NOTES THE CONTINUING LACK OF A CENTRAL FOCUS IN THE NAVY ON MODELING & SIMULATION."

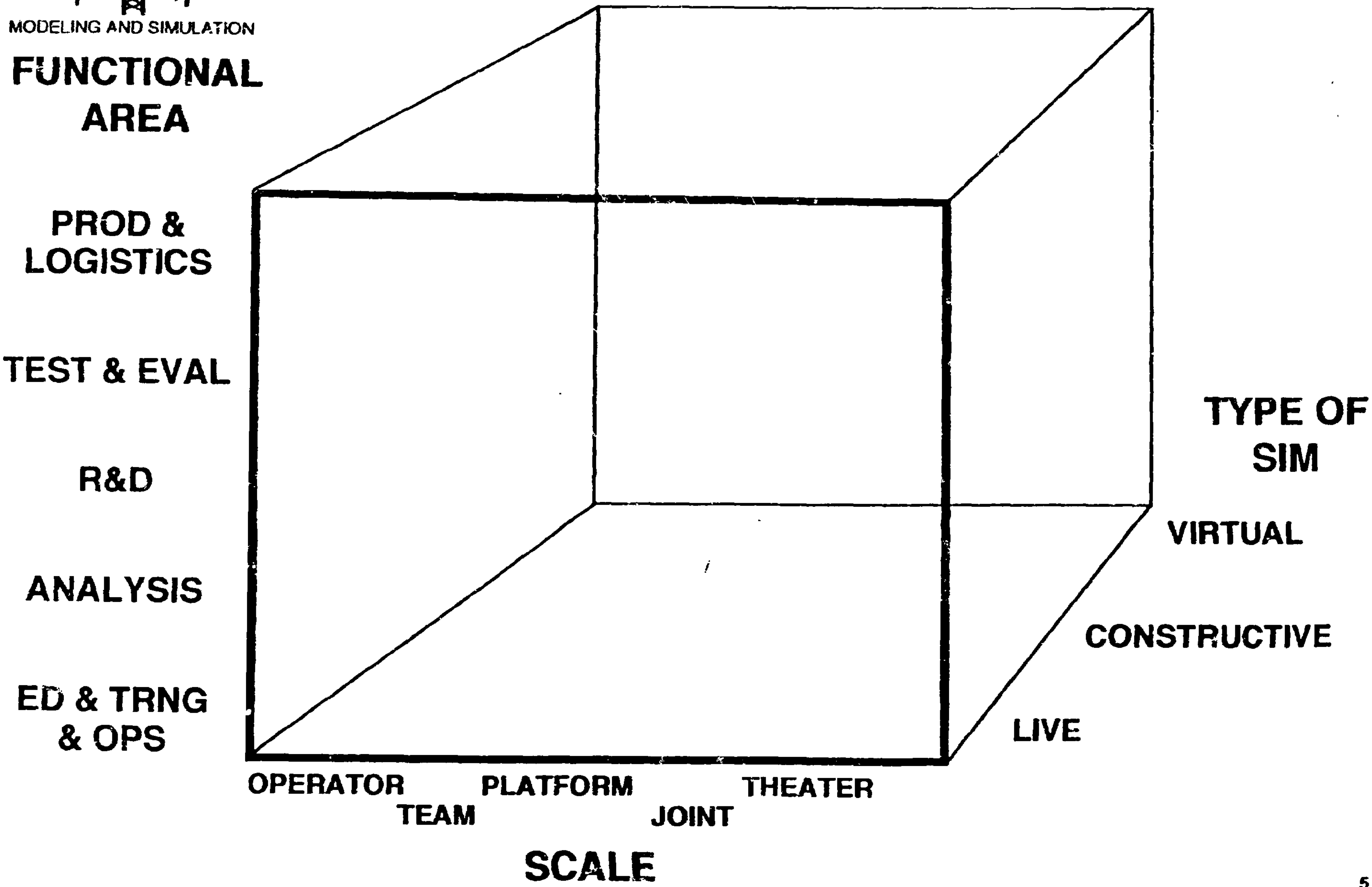
- "THE NAVY HAS BEEN IN THE FOREFRONT OF M&S AT THE TECHNICAL LEVEL, THOUGH MOST OF THE ACTIVITIES ARE UNDERTAKEN IN THE FIELD AND THERE HAS BEEN LITTLE COORDINATION AND POOR OVERSIGHT OVER THESE ACTIVITIES."

- "A COORDINATED FOCUS IN THE DEPARTMENT OF NAVY COULD SUBSTANTIALLY IMPROVE THE NAVY'S LONG RANGE RESOURCES & OPERATIONAL PLANNING"

PUBLISHED IN THE "NATIONAL DEFENSE AUTHORIZATION ACT FOR FY94" REPORT ON 27 JULY 1993, BY THE SASC

UNITED STATES NAVY
MODELING AND SIMULATION

M&S DOMAINS



UNITED STATES NAVY
MODELING AND SIMULATION

N81 to N6

M&S SPECTRUM

P&L	T&E	R&D	ANALYSIS	ETMO
VIRTUAL PROTOTYPE MARITIME DEMO	IRIS ACETEF WARBREAKER MARITIME DEMO TCTS	MARS CWM CAAM AWB TAC BRAWLER SUPPRESSOR ENGINEERING MODELS	MARS CWM CAAM AWB ITEM IPAS TAC BRAWLER SUPPRESSOR ENWGS RESA WEPTAC	BFTT TCTS TASWIT CASES SYSTEM TRAINERS ENWGS RESA WEPTAC
PEOs PMs	OPTEVFOR PEOs PMs	ONR ARPA PEOs PMs WARFARE CTRs	PEOs PMs JMAs (N6, N8) N81	CINCs

UN STATES NAVY

MODELING AND SIMULATION

CURRENT VIEW

- UNCOORDINATED USE OF MODELS
- DISPARATE AND DUPLICATIVE MODEL DEVELOPMENT
- DISPARATE AND DUPLICATIVE DATA BASE DEVELOPMENT AND MAINTENANCE
- FEW MODELS AND SIMULATIONS HAVE ANY LEVEL OF V&V
- EXPENSIVE, INEFFECTUAL PARTICIPATION IN DISTRIBUTED SIMULATION EXERCISES AND DEMONSTRATIONS
- POOR TRANSITION OF M&S R&D EFFORTS TO NAVY PROGRAMS
- UNCOORDINATED EFFORTS TO BUILD TOOLS FOR THE FUTURE

UN STATES NAVY
MODELING AND SIMULATION

CHARACTERISTICS OF EFFECTIVE NAVY M&S MANAGEMENT

- RECOGNIZE M&S AS ONLY A TOOL
  - STUDY DIRECTORS RESPONSIBLE FOR STUDY RESULTS
  - USERS CHOOSE BEST TOOL FOR A JOB
  - USE OF TOOLS WITHIN A FUNCTIONAL AREA COORDINATED FOR MAXIMUM EFFECTIVENESS
- PROVIDE BEST CHOICES TO USERS
  - NECKDOWN AND REUSE
  - VERIFICATION AND VALIDATION
  - CATALOG OF POSSIBILITIES
- PLAN AND BUILD TOOLS FOR THE FUTURE
  - APPLY DISTRIBUTED SIMULATION ACROSS FUNCTIONAL AREAS
  - DATABASES
  - DEVELOP COMMON SIMULATION FRAMEWORK

UNITED STATES NAVY
MODELING AND SIMULATION

MANAGEMENT RESPONSIBILITIES

POLICY & TECHNICAL SUPPORT

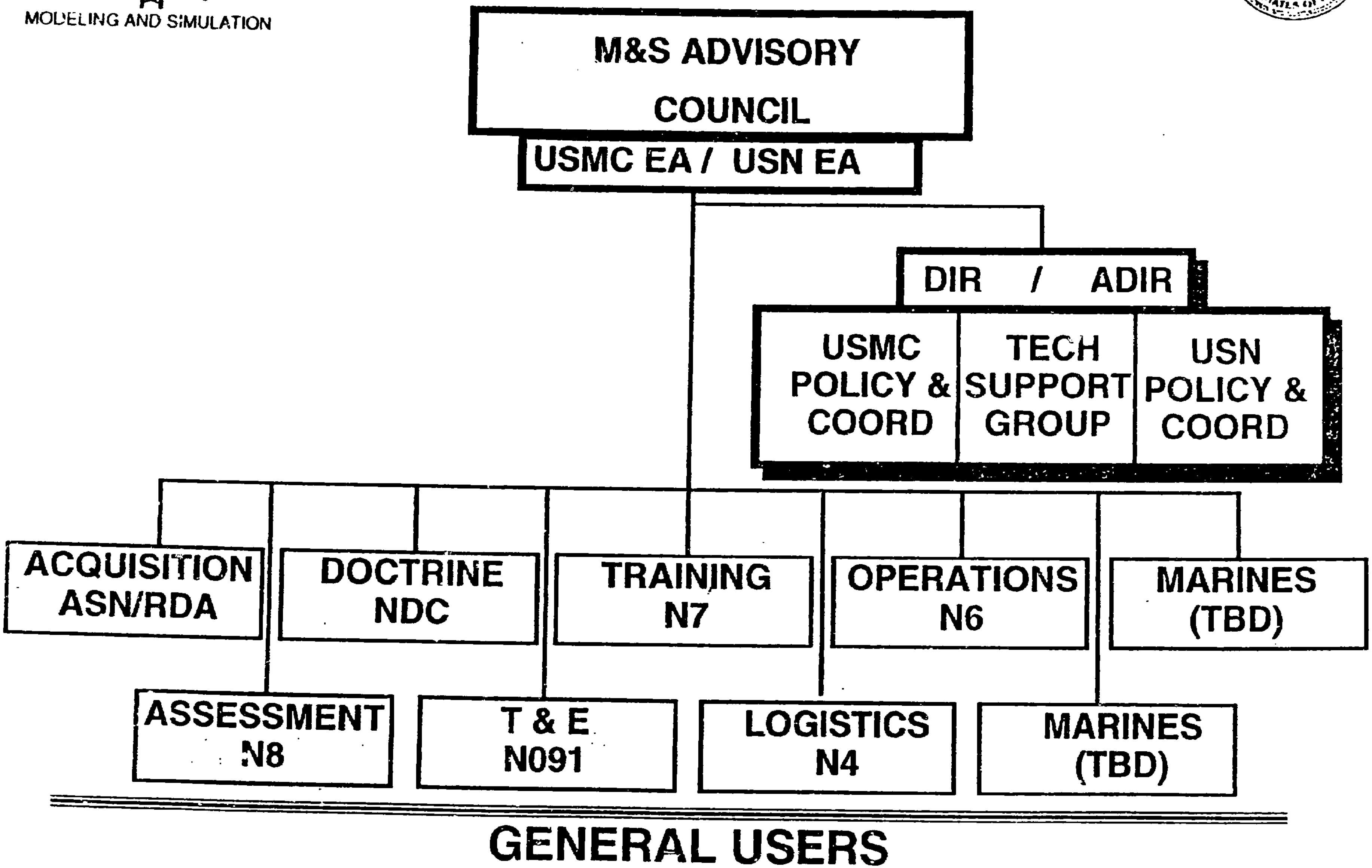
- DEVELOP AND PROMULGATE POLICY
- SET STANDARDS
  - NECKDOWN
  - REUSE
  - V&V
- SERVE AS POINT OF CONTACT WITH OUTSIDE AUTHORITY
- TECHNICAL RESOURCE
- BUILD FOR THE FUTURE

APPLICATION OF M&S

- CHOOSE APPROPRIATE MODELS AND SIMULATIONS FOR TASK AT HAND
- ACCREDIT MODELS AND APPROVE STUDIES
- COORDINATE TOOLS TO ACHIEVE MOST EFFECTIVE RESULTS
- PROVIDE VISION FOR USE OF TOOLS WITHIN A FUNCTIONAL AREA

UNITED STATES NAVY
MODELING AND SIMULATION

PROPOSED MANAGEMENT STRUCTURE



UNITED STATES NAVY

MODELING AND SIMULATION

M&S FUNCTIONAL AREA MANAGERS

ACQUISITION ASN/RDA

DOCT & TRNG SYS -- NDC

TRNG & EDUC N7

T & E N091

LOGISTICS N4

OPERATIONS N6

ASSESSMENT N8

- PROVIDE VISION FOR USE OF M&S TOOLS WITHIN FUNCTIONAL AREA
- WORK THROUGH M&S TECHNICAL SUPPORT GROUP TO FIND OR ACQUIRE MODELS AND SIMULATIONS
- SET UP ACCREDITATION PROGRAM, IF NEEDED
- SET UP FUNCTIONAL AREA V&V PROGRAM AS DESIRED
- FUND STUDIES, USE OF MODELS, AND DISTRIBUTED SIMULATIONS AS REQUIRED

UNITED STATES NAVY
MODELING AND SIMULATION

M&S POLICY, COORDINATION AND TECHNICAL SUPPORT

DIR / ADIR

USMC POLICY & COORD	TECH SUPPORT GROUP	USN POLICY & COORD

- WRITE AND MAINTAIN
  - SECNAV INSTRUCTION
  - V&V INSTRUCTION
- V&V OVERSIGHT

USMC POLICY & COORD

- WRITE AND MAINTAIN
  - MASTER PLAN
  - INVESTMENT STRATEGY
- COORDINATION
  - DMSO
  - JOINT

TECH SUPPORT GROUP

- V&V EXECUTION AND COORDINATION
- ONE STOP SHOP FOR M&S
- SUPPORT COMMON SIMULATION FRAMEWORK
- SUPPORT ADVANCED SIMULATION TECHNOLOGY

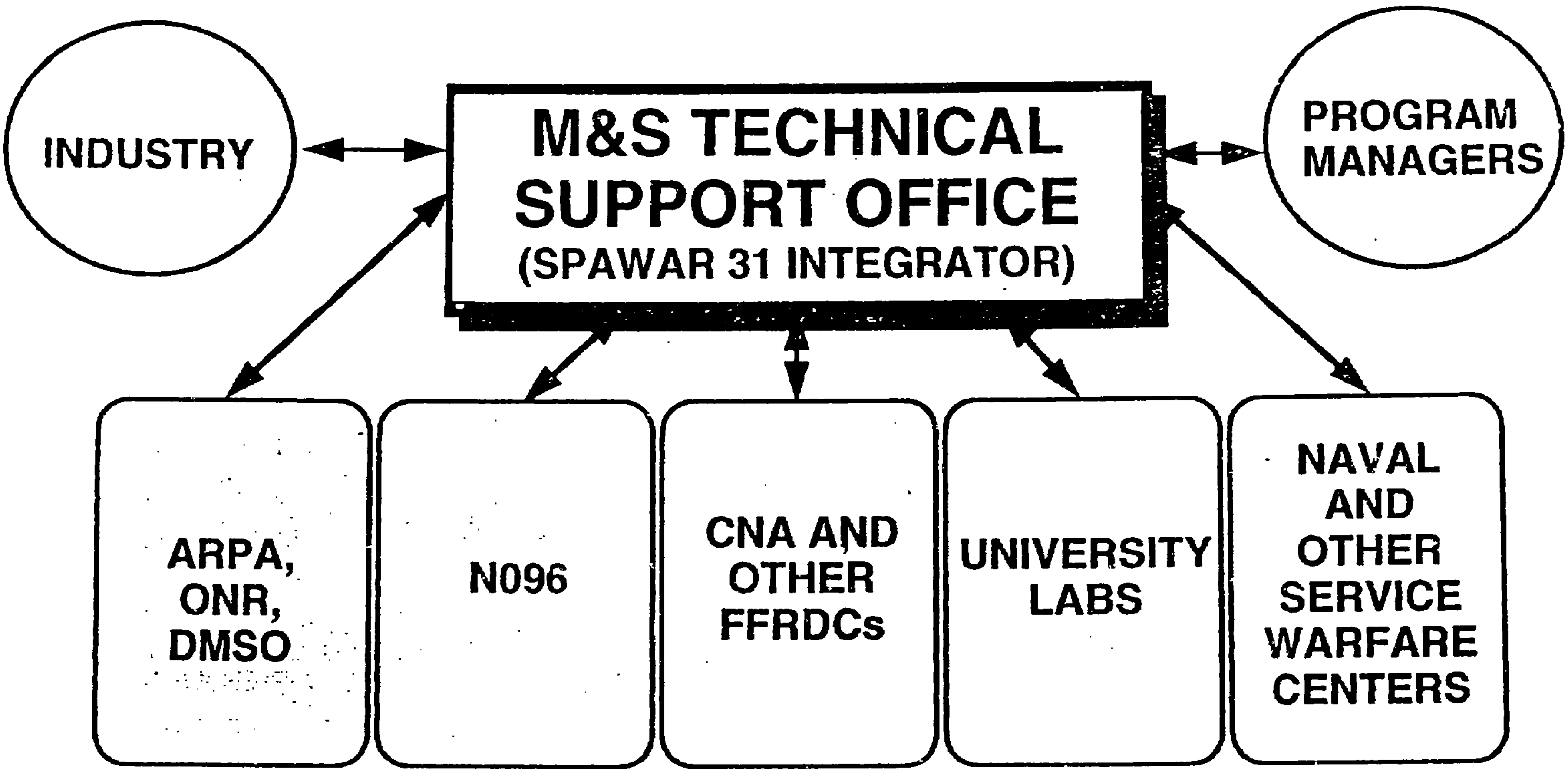
USN POLICY & COORD

- WRITE AND MAINTAIN
  - MASTER PLAN
  - INVESTMENT STRATEGY
- COORDINATION
  - DMSO
  - JOINT

UNI. ATES NAVY

MODELING AND SIMULATION

M&S TECHNICAL SUPPORT GROUP



SUMMARY

- NAVY HAS A M&S VISION
- ORGANIZATION APPROVED BY UNDERSECRETARY
  - COORDINATE USE OF MODELS
  - MODEL DEVELOPMENT
  - DATA BASE DEVELOPMENT AND MAINTENANCE
  - PARTICIPATE IN DISTRIBUTED SIMULATIONS AND DEMONSTRATIONS
  - TRANSITION M&S R&D EFFORTS TO NAVY PROGRAMS
  - COORDINATE FUTURE EFFORTS TO BUILD TOOLS
- TECHNICAL
  - PEO / PM / SYSCOM / LAB / CONTRACTORS KEY PLAYERS
  - NSS ESTABLISHES COMMON FRAMEWORK, STANDARDS, AND PROTOCOLS AND IS A PROTOTYPE FOR JSIMS
  - JSIMS PROVIDES JOINT VISION AND FUTURE M&S FRAMEWORK
- DISTRIBUTED EXPERIMENTS KEY PART OF APPLICATIONS
- AUTOMATED REPOSITORY FOR MODELING & SIMULATION
- V,V, &A

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ARMS

AUTOMATED REPOSITORY FOR MODELS AND SIMULATIONS

DMSO I/DB

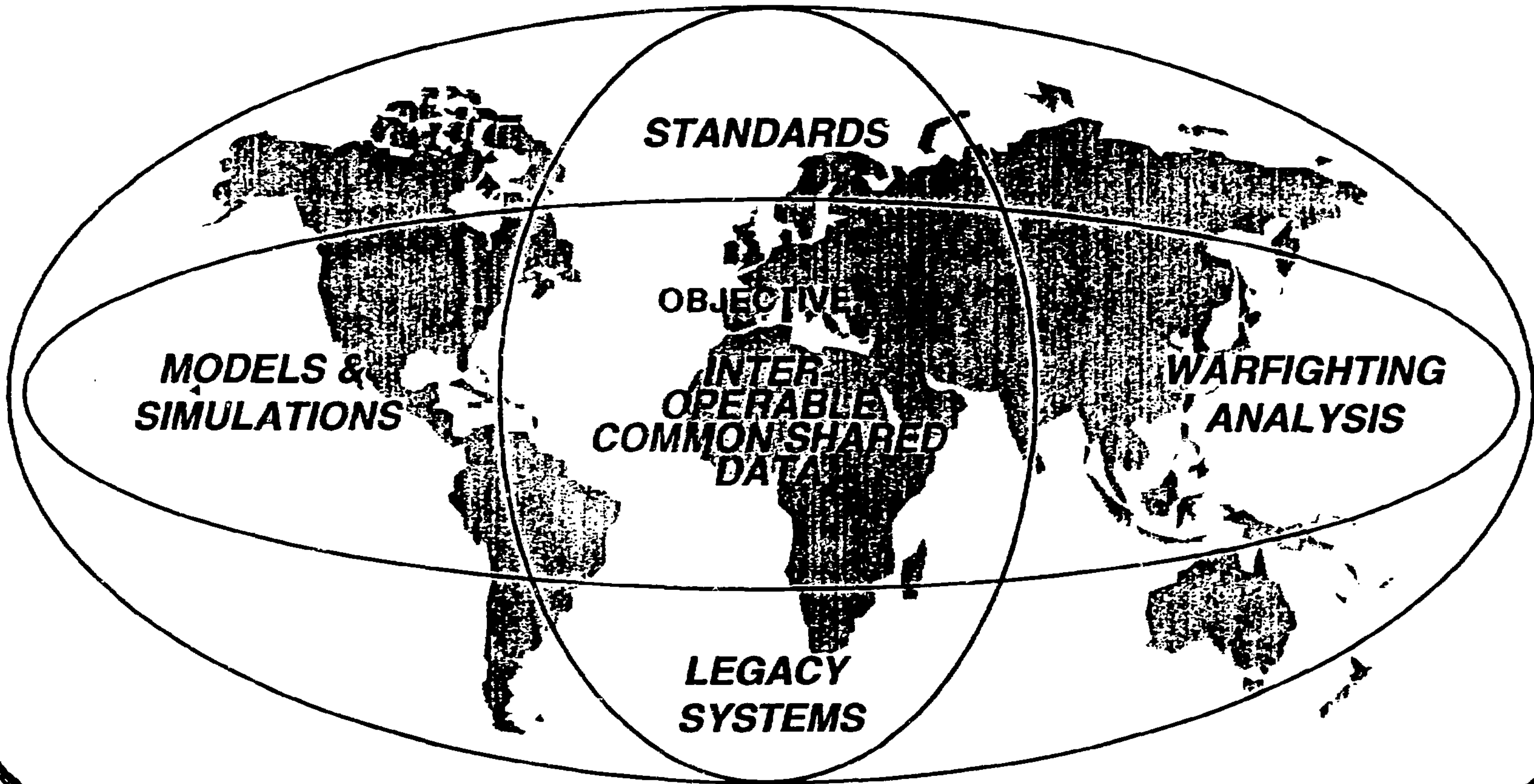
12 July 1994

LCDR George Flax
DON M&S TSG
(703) 602-1763
flaxg@smtp-gw.spawar.navy.mil

ARMS

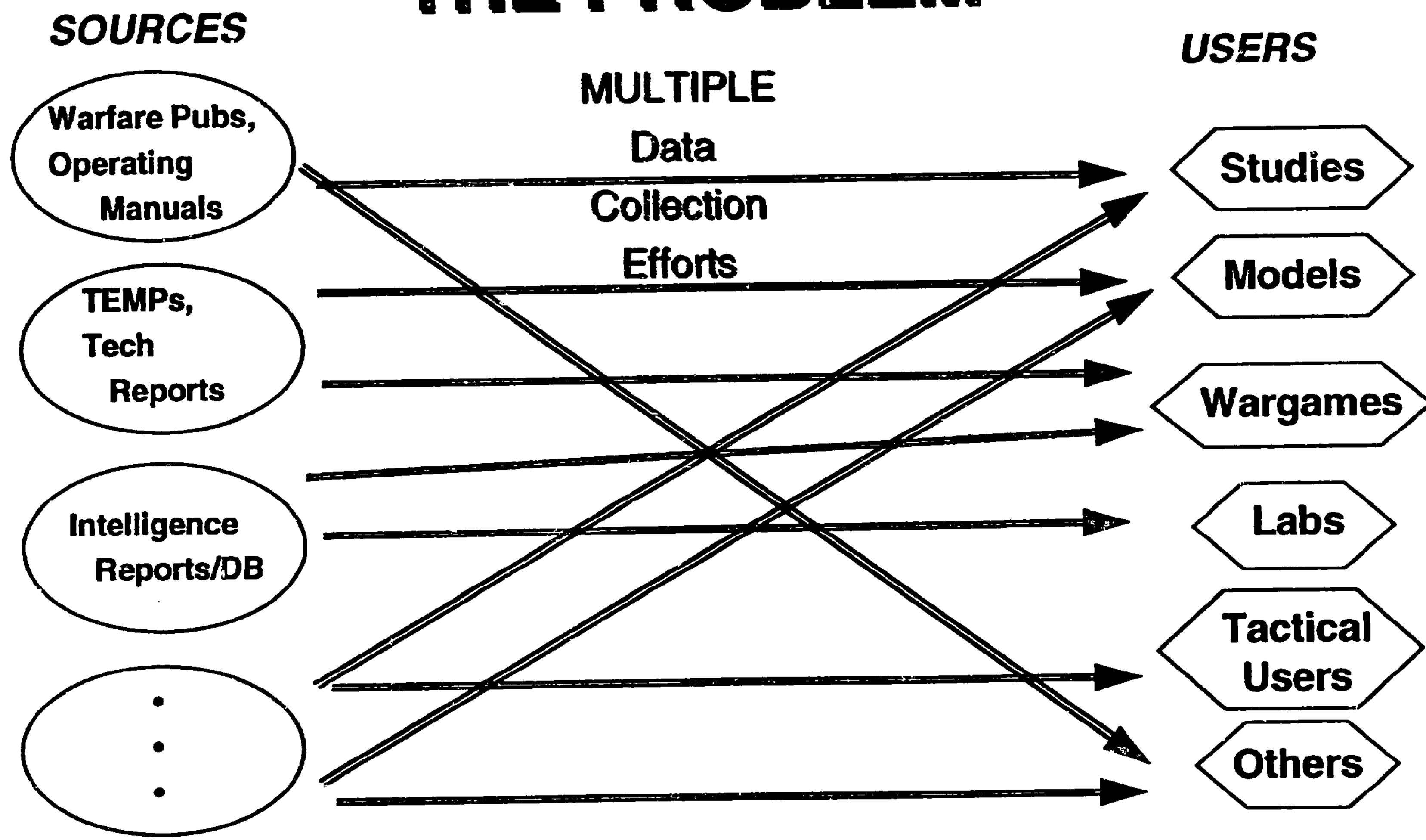
Automated Repository for Models and Simulations

To Provide Common, Authoritative Data Source
for Joint Warfare Analysis



ARMS

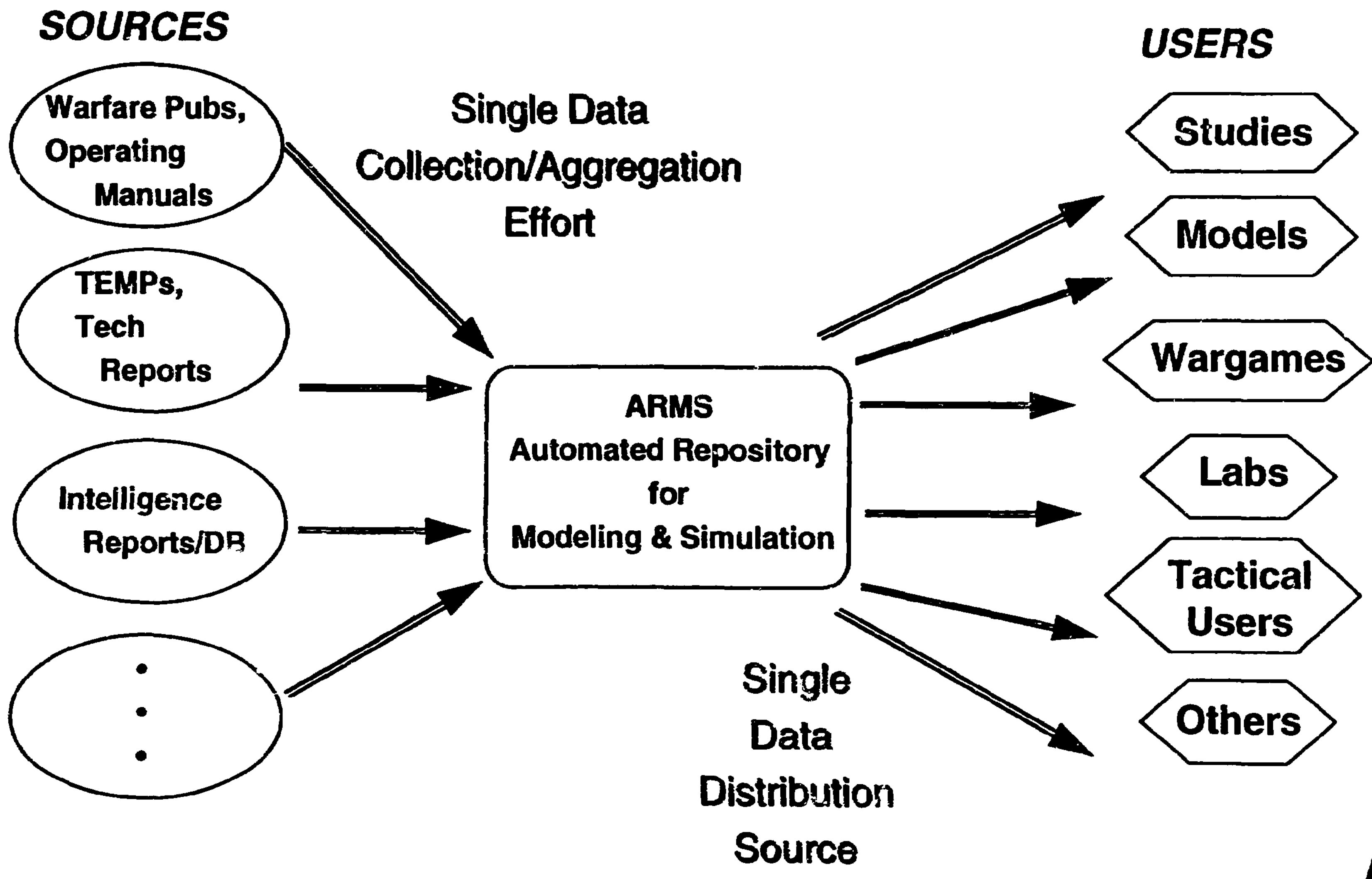
THE PROBLEM



- No Common Frame of Reference for Assessments and Analysis
- Source Dependent User Interfaces
- Redundant Data Gathering and Dissemination Efforts

ARMS

ARMS - THE SOLUTION



ARMS Objectives

- Consolidate redundant data gathering and distribution efforts
- Ensure a reliable source of authoritative data for use in assessments and warfighting analysis
- Provide a bridge between legacy data sources and models, and those conforming to emerging standards
- Establish a *Data "Clearing House"* for electronic distribution to models, simulations and users in the analysis and assessment communities
- Provide *Blue Force data* for the Naval Warfare Tactical Database (NWTDB)
- Centralized Configuration Control and Repository Management

ARMS Is...

- A system that *currently exists*
- A repository and distribution technology
  - MORE THAN JUST A DATABASE
- A data collection, consolidation and distribution effort:
  - Provides a single user interface to data from heterogenecus sources
  - Provides *traceable, authoritative data* (source tagged)
  - *Reduces redundant data collection/capture*
  - Enhances legacy system capabilities through the mapping between standard and non-standard data structures

ARMS Current Status

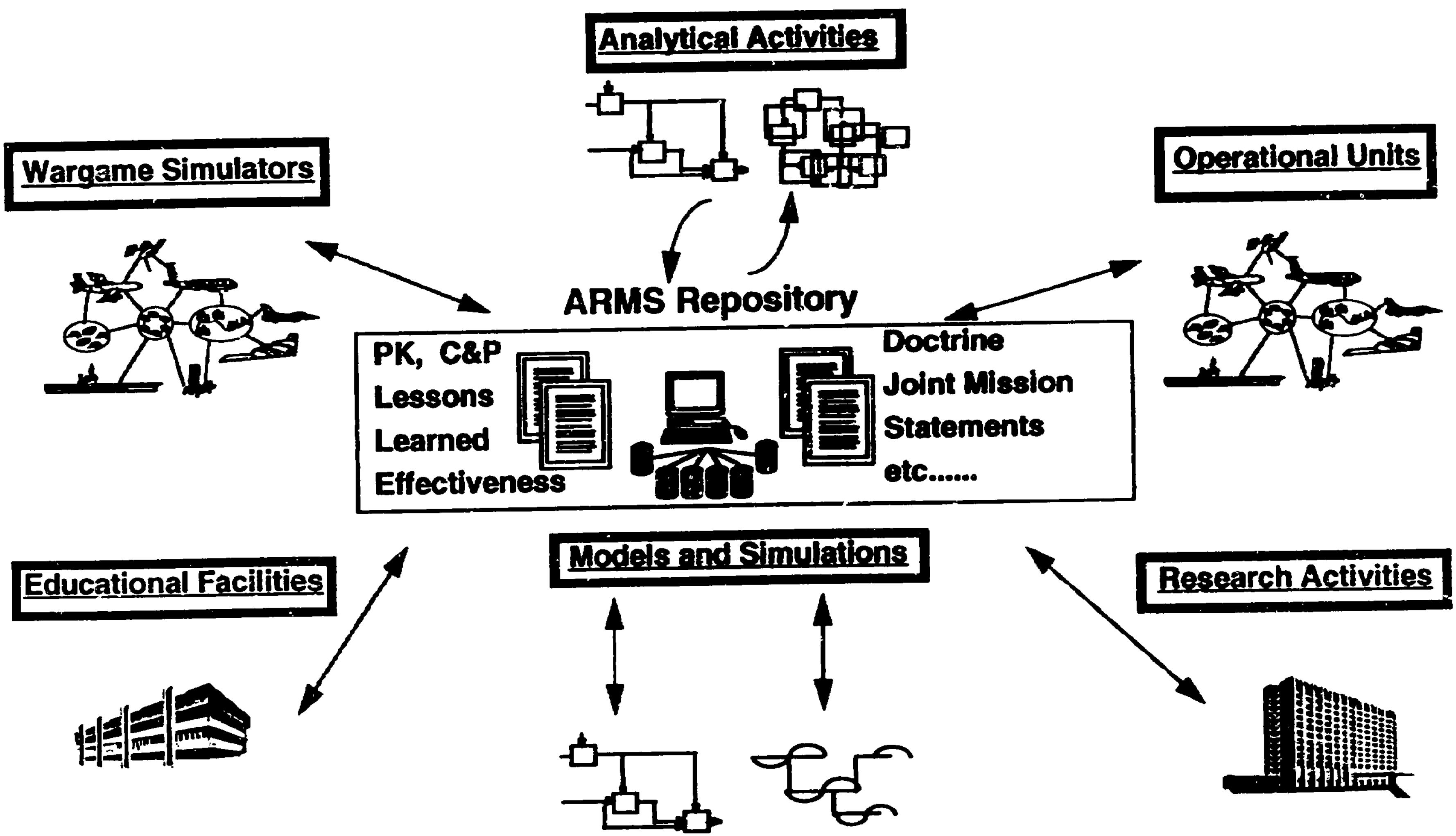
- Currently implemented on the Macintosh. Operating on HP and Sun workstations.
- Available Data (Characteristics, Performance and Effectiveness)
  - Current and Future Time-Frame Blue
    - » NAVY and MARINE AIRCRAFT
    - » SHIPS and SUBMARINES
    - » ASSOCIATED SYSTEMS and WEAPONS
  - Current Time-Frame Red (Partial Set)
    - » INSTALLATIONS (Airbases, EWGCI & SAM Sites, Targets)
    - » RED PLATFORMS and WEAPONS (Air and Sea)
- Interface to Integrated Theater Engagement Model (ITEM)

ARMS

ARMS Development Plan

- Incorporate a fusion of commercial off the shelf software & hardware with new technology to achieve the system objectives
  - Object Oriented Database Management Systems
  - Object Request Brokers
  - Meta Dictionaries
  - Mediators
  - Heterogeneous databases with object encapsulation
  - remote dial in servers
  - Relational database mapping functions
  - etc. . . .
- The technological foundation has been laid to share data from disparate information sources through a common method

ARMS role in the "Big Picture"



DMSO

presented at the

Information/Data Base Technology Working Group Meeting

Defense Modeling and Simulation Office *(DMSO)*

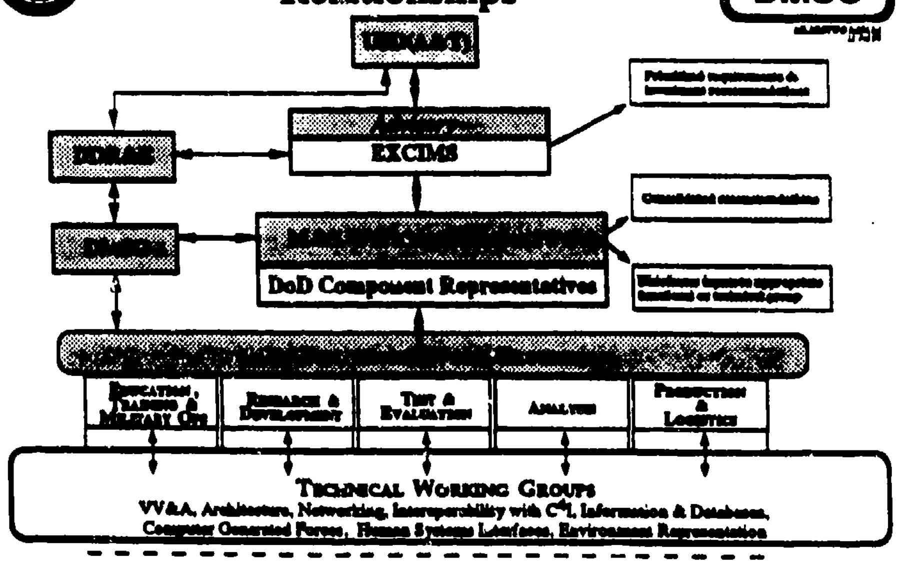
Update

12 July 1994

Michael Lilienthal, PhD, CPE
CDR, MSC, USN

Relationships

DMSO



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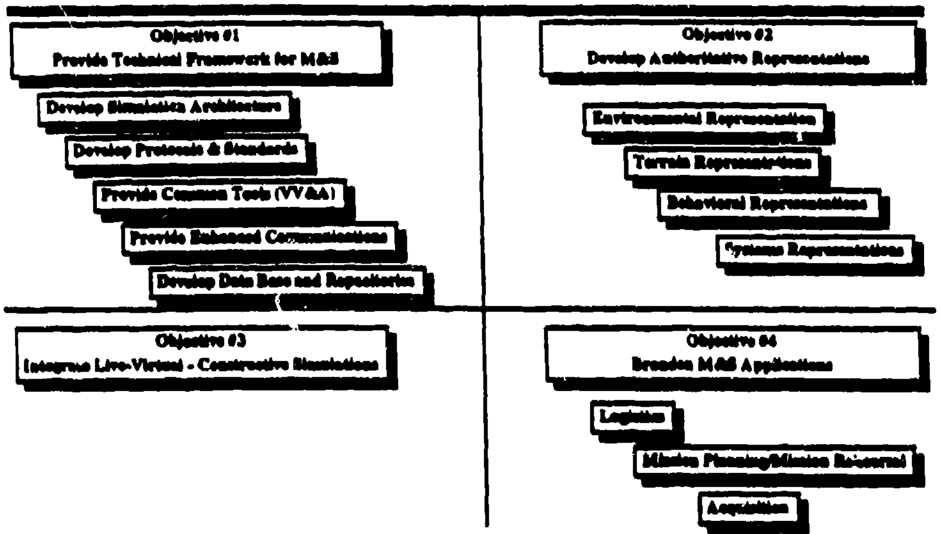
Objective Action Plans

DMSO



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Sub-Objectives Outline

DMSO

- Introduction
- Objective
- Needs
- Vision
- Current Assessments
- Roadmaps
- Recommendations/Follow-on Issues

6

Functional Working Groups
(FWGs)

DMSO

TASKS

- Validate Needs
- Prioritize the Sub-Objectives
- Identify Major Component Programs
- Participate in Integrated Process Teams

FWGS	MEETING DATE
• Education, Training and Military Operations *(ETMO)*	*May '94*
• Analysis	*21 June '94*
• Research & Development *(R&D)*	*8 June '94*
• Production & Logistics *(P&L)*	*15 June '94*
• Test & Evaluation *(T&E)*	*14 June '94*

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M&S Master Plan Outline

DMSO

Main Body
- Section 1: Introduction
- Section 2: Vision
- Section 3: Goal and Objectives
- Section 4: Organizations Supporting Defense M&S
- Section 5: Implementation Strategy

Appendix A: Objective #1: Provide Technical Framework for M&S
- A.1: Architecture
- A.2: Data Bases
- A.3: VV&A
- A.4: Networks & Communications

Appendix B: Objective #2: Develop Authoritative Representations
- B.1: Terrain
- B.2: Environmental Representations
- B.3: Behavioral Representation
- B.4: Systems Representation

Appendix C: Objective #3: Integrate Live, Virtual, and Constructive Simulations

Appendix D: Objective #4: Broaden M&S Applications
- D.1: Logistics
- D.2: Mission Planning/Mission Rehearsal
- D.3: Acquisition

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FY95 Investment

DMSO

I/DBTWG

Infrastructure

FY94 IPL Tails

Under Consideration
Logistics
Acquisition
Test & Evaluation

Focused Areas

Build On Interoperability

Build On Jointness Up Front

- Mission Rehearsal/ Mission Planning
- Terrain
- CGF/SAFOR

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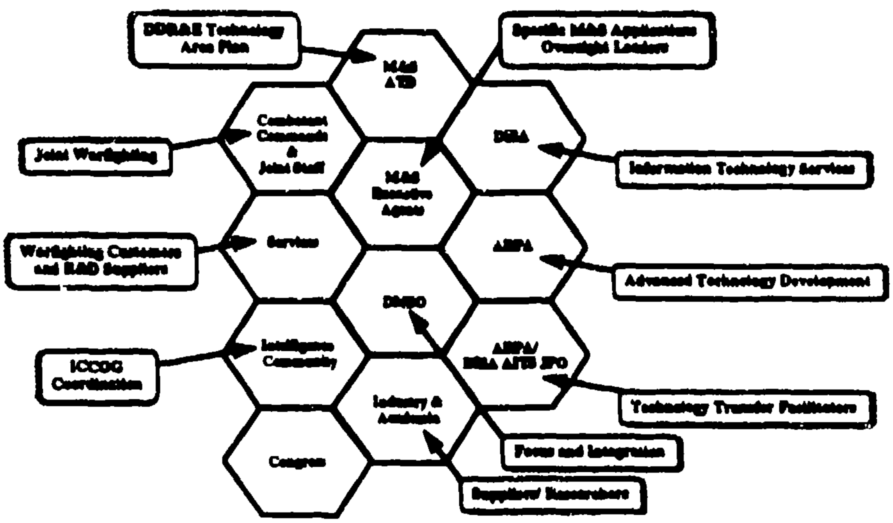
Key Organizations Supporting Defense Modeling & Simulation

DMSO



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Persistence

Nothing in the world,
can take the place of persistence.

Talent will not...
nothing is more common than
unsuccessful men with talent

Genius will not...
unrewarded genius is almost a proverb

Education will not...
the world is full of educated derelicts

Persistence and determination alone
are omnipotent

The slogan "Press On" has solved and
will solve the problems of the human race.

Calvin Coolidge

ANALYSIS
FUNCTIONAL WORKING GROUP

Dr. Patricia Sanders

12 July 1994

ANALYSIS SUPPORTS THE DECISIONMAKER

PROCESS	CUSTOMER	PRODUCTS
REQUIREMENTS	JROC, OPERATIONAL COMMANDERS, CINCs,...	MISSION AREA ANALYSIS, WARGAME ANALYSIS, BATTLE LAB OUTPUT,...
PPBS	DRB, PROGRAMMERS,...	RESOURCE ALLOCATION STUDIES, VALUE ADDED ANALYSIS,...
ACQUISITION	DAB, PEOs/PMs,...	COST AND OPERATIONAL EFFECTIVENESS ANALYSIS, AFFORDABILITY ASSESSMENTS, TRADE STUDIES,...

AFWGMC4

EFFECTIVE ANALYSIS IS:

- RELEVANT
- RESPONSIVE
- CREDIBLE

RELEVANT ANALYSIS NEEDS:

- MODELS AND SIMULATIONS THAT ADDRESS THE QUESTIONS OF INTEREST TO THE DECISIONMAKER
  - CURRENT ROLES, MISSIONS, OPERATIONS
  - ACCURATE REPRESENTATION OF TODAY'S THREAT AND TOMORROW'S DANGERS
  - CONSIDERATION OF JOINT / COALITION ACTIONS

- MODELS AND SIMULATIONS THAT INCLUDE THE FACTORS TO WHICH THE DECISION IS SENSITIVE
  - ENVIRONMENT
  - HUMAN BEHAVIOR
  - C3I

AFWGMC6

RESPONSIVE ANALYSIS NEEDS:

- DATA BASES
  - ACCURATE DATA FOR TERRAIN, ATMOSPHERE, BEHAVIOR, WEAPONS PERFORMANCE, COST,...
  - ACCESSIBILITY
- RAPID SCENARIO GENERATION
- ANALYST FRIENDLY M&S TOOLS:
  - DEVELOPMENT
  - EMPLOYMENT
  - REPORTING
- PC-BASED MODELS AND SIMULATIONS

AFWGMC7

CREDIBLE ANALYSIS NEEDS:

- CONFIDENCE IN THE ANALYTIC TOOLS
  - STANDARDS
  - VERIFICATION, VALIDATION, AND ACCREDITATION PROCEDURES AND TECHNOLOGIES
- CONFIDENCE IN THE ANALYST
  - EDUCATION AND TRAINING
  - PROFESSIONAL INTERCHANGE
  - COMMUNICATION WITH THE DECISIONMAKER

AFWGMC8

CHALLENGE:

DEVELOP THE

MODELING AND SIMULATION CAPABILITY

THAT THE DEPARTMENT OF DEFENSE NEEDS

TO MAKE

INFORMED AND EFFECTIVE DECISIONS

IN TODAY'S DEMANDING ENVIRONMENT

AOC14

PRODUCTION & LOGISTICS (P&L) FUNCTIONAL WORKING GROUP (FWG)

BRIEFING TO THE

INFORMATION DATA BASE TECHNICAL GROUP (I/DBTG)

JULY 12, 1994

FRED MYERS

P&L FWG CHAIRMAN

OUTLINE

- P&L FWG ORGANIZATION
- MODELING & SIMULATION (M&S) NEEDS GENERATION
- PRODUCTION NEEDS
- LOGISTICS NEEDS
- DATA MANAGEMENT CONCERNS
- RECENT CHANGES

P&L FWG ORGANIZATION

- ESTABLISHED IN DECEMBER 1991 BY ASD(P&L)
- CHARTER
  - FOSTER A REALISTIC PORTRAYAL OF PRODUCTION (INCLUDING INDUSTRIAL BASE CAPABILITIES) AND LOGISTICS CONSIDERATIONS IN WAR GAMES AND SIMULATION
  - PROMOTE USE OF REAL WORLD MODELS TO BRING BATTLEFIELD OPERATIONS AND MAINTENANCE REQUIREMENTS TO THE PRODUCT DESIGN PROCESS
  - CREATE A METHODOLOGY FOR EVALUATING PRODUCTION AND LOGISTICS M&S NEEDS
- MEMBERS FROM: OSD, JOINT STAFF, SERVICES, AND DLA

M&S NEEDS GENERATION

- NOVEMBER 1992 WORKSHOP
  - MEMBERS FROM ALL SERVICES AND OTHER AGENCIES PRESENT
  - KEY FUNCTIONAL NEEDS IDENTIFIED
    - » PRODUCTION (6)
    - » LOGISTICS (9)
- JUNE 1994 - THE P&L FWG UPDATED AND REVALIDATED M&S NEEDS

PRODUCTION NEEDS

- PRODUCTION/MANUFACTURING TOOLS FOR INTEGRATED PRODUCT AND PROCESS DEVELOPMENT
- TECHNICAL PROCESSES AND DATA MODELS: PRODUCTION CONTROL AND SHOP FLOOR CONTROL MODELS
- MODELING AND SIMULATION SUPPORT OF REMANUFACTURING AND REPAIR
- COORDINATION WITH NATIONAL AND INTERNATIONAL STANDARDIZATION EFFORTS

PRODUCTION NEEDS (CONTINUED)

- POLICY AND MANAGEMENT DIRECTION ON STANDARDIZATION OF M&S
- INDUSTRIAL BASE RECONSTITUTION

LOGISTICS NEEDS

- HIGHER FIDELITY REPRESENTATION OF LOGISTICS IN COMBAT MODELS
- CREDIBLE LOGISTICS DATABASES AND DATA COLLECTION CAPABILITIES
- A PLANNING/EXECUTION TOOL TO SUPPORT THE CINCs IN OPLAN ASSESSMENTS
- AN ANALYSIS TOOL TO STUDY THE EFFECTS OF FORCE SIZING AND UNIT REALIGNMENT ON LOGISTICS INFRASTRUCTURE
- ACQUISITION LOGISTICS MODELING

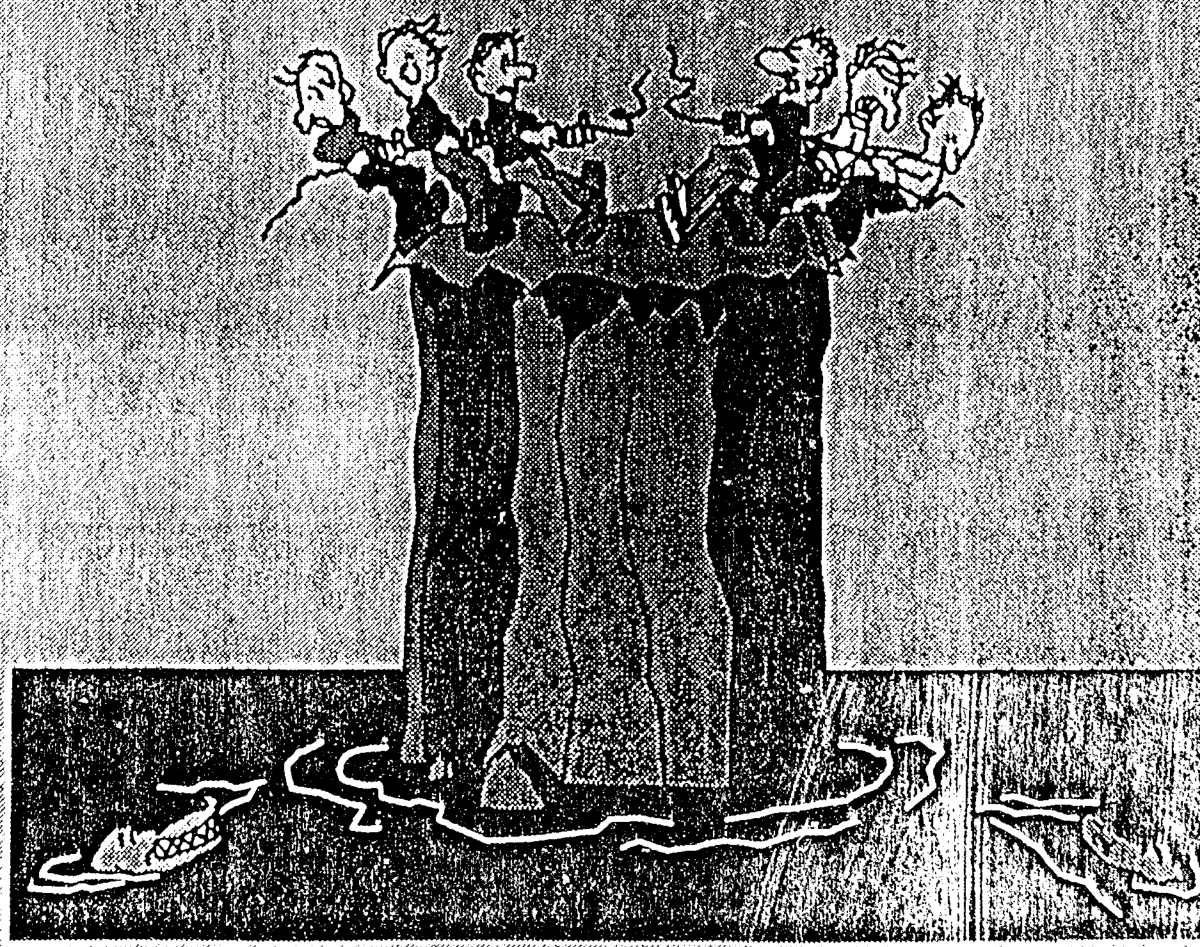
LOGISTICS NEEDS (CONTINUED)

- CAPABILITY TO QUANTIFY IMPLICATIONS OF ALTERNATIVE MATERIEL MANAGEMENT POLICIES
- AN ANALYSIS CAPABILITY TO EVALUATE NDI/COTS EQUIPMENT PERFORMANCE PRIOR TO PURCHASE
- INTERFACES BETWEEN LIVE, VIRTUAL, AND CONSTRUCTIVE MODELS
- TOOLS TO SUPPORT LOGISTICS CONSIDERATIONS IN THE PPBS PROCESS

DATA MANAGEMENT CONCERNS

- SHARING DATA IS DIFFICULT WITHOUT COMMON DATA SETS
- ABSENCE OF DATA STRUCTURES MAKES IT MORE DIFFICULT TO DETERMINE DATA USABILITY AND TO INDEPENDENTLY VALIDATE AVAILABLE DATA
- DEVELOPMENT OF INTER-RELATED MODELS IS HAMPERED BY ABSENCE OF RECOGNIZED DATA STRUCTURES
- CONSISTENCY OF RESULTS BETWEEN MODELS IS HARDER TO ACHIEVE WITHOUT RECOGNIZED DATA STRUCTURES
- BOTTOM LINE: WE CANNOT EFFECTIVELY USE M&S CAPABILITIES WITHOUT COMMON DATA SETS AND RECOGNIZED DATA STRUCTURES

RECENT DEVELOPMENTS



REALIGNED FUNCTIONAL AREA RESPONSIBILITIES

- OASD (ES)
  - ACQUISITION LOGISTICS
  - RELIABILITY & MAINTAINABILITY
  - MANUFACTURING/REMANUFACTURING
  - INDUSTRIAL BASE
- DUSD(L)
  - OPERATIONAL LOGISTICS
  - TRANSPORTATION
  - MATERIAL MANAGEMENT
  - MAINTENANCE

SUMMARY

- DATA AND DATA MANAGEMENT ISSUES ARE KEY TO SUCCESSFUL IMPLEMENTATION OF M&S
- ENSURE THAT KEY PLAYERS ARE INVOLVED IN YOUR ACTIVITIES
- CHANGES ARE INEVITABLE

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E^{2}DIS

Environmental Effects for Distributed Interactive Simulation

An Object-Oriented Technology for Integrating Environmental Effects & Distributed Simulations

Harry Heckathorn

E^{2}DIS Program Manager &
Chairman of the E^{2}DIS Technical Management Council

Naval Research Laboratory
Office of Strategic Phenomena, Code 7504
Washington, DC 20375-5352
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Presented to
DMSO Information Data Base Technology Working Group (I/DBTWG)
12 July 1994

HMH:94-07-12

Mission Statement
Naval Research Laboratory
Office of Strategic Phenomena

- The Office of Strategic Phenomena consolidates Space Science Division activities associated with experimental and modeled data of background, target and environmental phenomena as they relate to the design of strategic, theater, and tactical military systems.
- The mission is to develop and maintain the means by which certain phenomenology data is to be archived, distributed, analyzed and used by the community of designers, experimenters, scientists, and wargamers working in the areas such as ballistic missile defense or in synthetic environments for more comprehensive DoD simulations.
- In the case of modeled data, the mission extends to the means by which such realizations are generated, verified, and validated for use in the design, simulation, and test of surveillance sensors and both defensive and offensive system concepts.
- The experimentally derived data pertains primarily to natural backgrounds and environments whereas the modeled data includes representations of phenomena of man-made origin, both as viewed principally from space.

Current Projects
Naval Research Laboratory
Office of Strategic Phenomena

Synthetic Scene Generation Model
SSGM

The standard BMD modeling tool for generating multi-phenomenology, synthetic imagery data relating to strategic backgrounds and targets

Backgrounds Data Center
BDC

The phenomenology data center for BMD experimental products relating to terrestrial, atmospheric, and celestial backgrounds

Environmental Effects for
Distributed Interactive Simulation
E^2DIS

The DMSO sponsored effort to provide the means to incorporate sufficient and realistic environmental representations, effects & processes consistently into Distributed Interactive Simulations

E²DIS

Mission & Goals

Mission Statement

To the extent that they impact weapon system performance and attrition, provide the means to incorporate sufficient and realistic environmental representations, effects & processes consistently in distributed interactive simulations.

Goals: Provide E&E² infrastructure for

- Sensor Response — recon, surveil, acquire, track, assess ...
- Platform Motion — performance, trafficability, velocity, acceleration ...
- Decision Aids & Human Factors — use of environmental knowledge

An Important Specific Goal

"To achieve the high fidelity simulation of sensor detection of targets"

— From the DMSO technical evaluation of E²DIS proposals

E²DIS

Modeling Issues for Distributed Interactive Simulation (DIS)

- Adequate modeling of E&E² is critical to the *realistic* simulation of battlefield activity (sensing, moving, decision making).
- Realism, while desirable, is not an end unto itself — *attrition is what counts*. If E&E² doesn't effect the outcome of a simulated battle, it's inclusion in DIS is difficult to justify.
- *Sufficient-fidelity, physics-based* models and databases are required to handle the variety and dynamics of the real world.
- A broad *range of scales and levels of fidelity* are required to address strategic through tactical issues.
- The DIS architecture must handle *dynamic environments* in interactive, real-time mode for virtual simulation.
- *Consistent representation & treatment* of E&E² is critical for a "fair-flight".

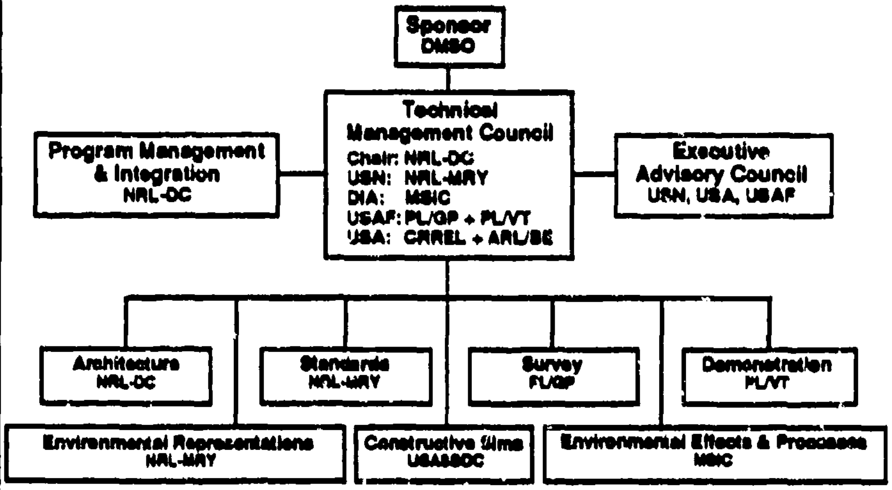
Fundamental E²DIS Jobs

- Develop methods to ensure common E&E² across cells
  - Communication, a significant part of the E2DIS problem, can be separated from the physics
- Find optimal solutions by testing against an *objective function*
  - Maximize correlation of E&E² while minimizing bandwidth requirements
- Explore various methods to achieve goal of high correlation
  - Compute & distribute environmental information prior to the simulation
  - Transmit environmental data or change information (transformations derived from models) over the network
  - Keep environmental information at one place (server)
  - Dead-reckon both E and E²
  - Others ...
- Judge solutions by how well they measure up to the objective function but temper these judgments with pragmatic requirements
  - Speed, portability, DIS compatibility, ease of implementation
- Adopt a workable development process
  - Choose a set of problems (sensor-target coupling, mobility, ...)
  - Cut code, measure performance, iterate

E²DIS Participants

- USN — Naval Research Lab., Space Sciences Div. (NRL-DC)
  - — Naval Research Lab., Marine Meteorology Div. (NRL-MRY)
  - — Naval Postgraduate School, Dept. of Computer Sciences (NPS)
- USAF — Phillips Lab., Geophysics Dir. (PL/GP)
  - — Phillips Lab., Space & Missiles Technology Dir. (PL/VT)
  - — Wright Lab. (WL)
  - — Air Force Operational Test and Evaluation Ctr. (AFOTEC)
- USA — Cold Regions Research & Engineering Lab. (CRREL)
  - — Construction Engineering Research Labs. (CERL)
  - — Army Research Lab., Battlefield Environment Dir. (ARL/BE)
  - — Test & Experimentation Cmd. Experimentation Ctr. (TEC-FHL)
  - — TRADOC Analysis Cmd. (TRAC-MRY)
  - — Space & Strategic Defense Command (USASSDC)
- DIA — Missile & Space Intelligence Ctr. (MSIC)
- UCF — Univ. of Central Florida, Inst. of Simulation & Training (IST)
- UI — Univ. of Illinois, Dept. of Mathematics (UI)

E²DIS Organization



Summary of E²DIS System Design & Development
(The Eight Task Areas)

- ***Management & Integration*** — Coordinate the seven technical tasks
- ***Architecture*** — Analyze, design, implement the means to incorporate E&E² into distributed simulations using DIS standards
- ***Survey Requirements & Capabilities*** — Identify requirements for E&E² by simulators and define state-of-science modeling capabilities
- ***Standards*** — Define standard database structures, transfer formats, and messages to allow information on E&E² to be used in DIS
- ***Environmental Representations*** — Develop automated methodologies & procedures to put numerical environmental data into standard form
- ***Environmental Effects & Processes*** — Provide sufficient-fidelity, physics-based environmental effects & process models and make them available to simulators using the E²DIS architecture
- ***Demonstration*** — Prove that the E²DIS implementation is viable
- ***Constructive Simulations*** — Provide the means to represent E&E² in constructive simulations

E²DIS

Summary of E²DIS System Design & Development
(The Eight Task Areas - Chart 1)

Management & Integration

Provide for coordination of the seven technical task areas such that an integrated and proven E²DIS system and associated documentation is developed and that all program goals are achieved.

~~Architecture~~ Methodology

Provide a valid design and verifiable implementation that allows the incorporation of appropriate fidelity physics of the environment and environmental effects seamlessly into distributed simulations. The design & implementation shall be open, reusable, and shall use current DIS standards — or new ones proposed as necessary.

E²DIS

Summary of E²DIS System Design & Development
(The Eight Task Areas - Chart 2)

Survey Requirements & Capabilities

Define required simulation environments and provide basis for selecting natural environment, environmental effects, & environmental process models.

Standards

Facilitate and simplify the transfer of information on the synthetic physical environment used in distributed simulations by developing standard database structures, transfer formats, prototype standard databases, and DIS environmental messages (Protocol Data Units: PDUs).

Summary of E²DIS System Design & Development
(The Eight Task Areas - Chart 3)

Environmental Representations

Facilitate the creation and representation of synthetic environments by developing methodologies to treat numerical environmental databases & feature models. That is, to provide the means to put environmental data into standard form such that inherent temporal and spatial variability is retained while ensuring that the representation is scaleable to the constraints & capabilities of different simulators.

Environmental Effects & Processes

Select, modify, or create sufficient-fidelity, physics-based environmental effects & process models and to make them available to simulators through the E²DIS architecture.

Summary of E²DIS System Design & Development
(The Eight Task Areas - Chart 4)

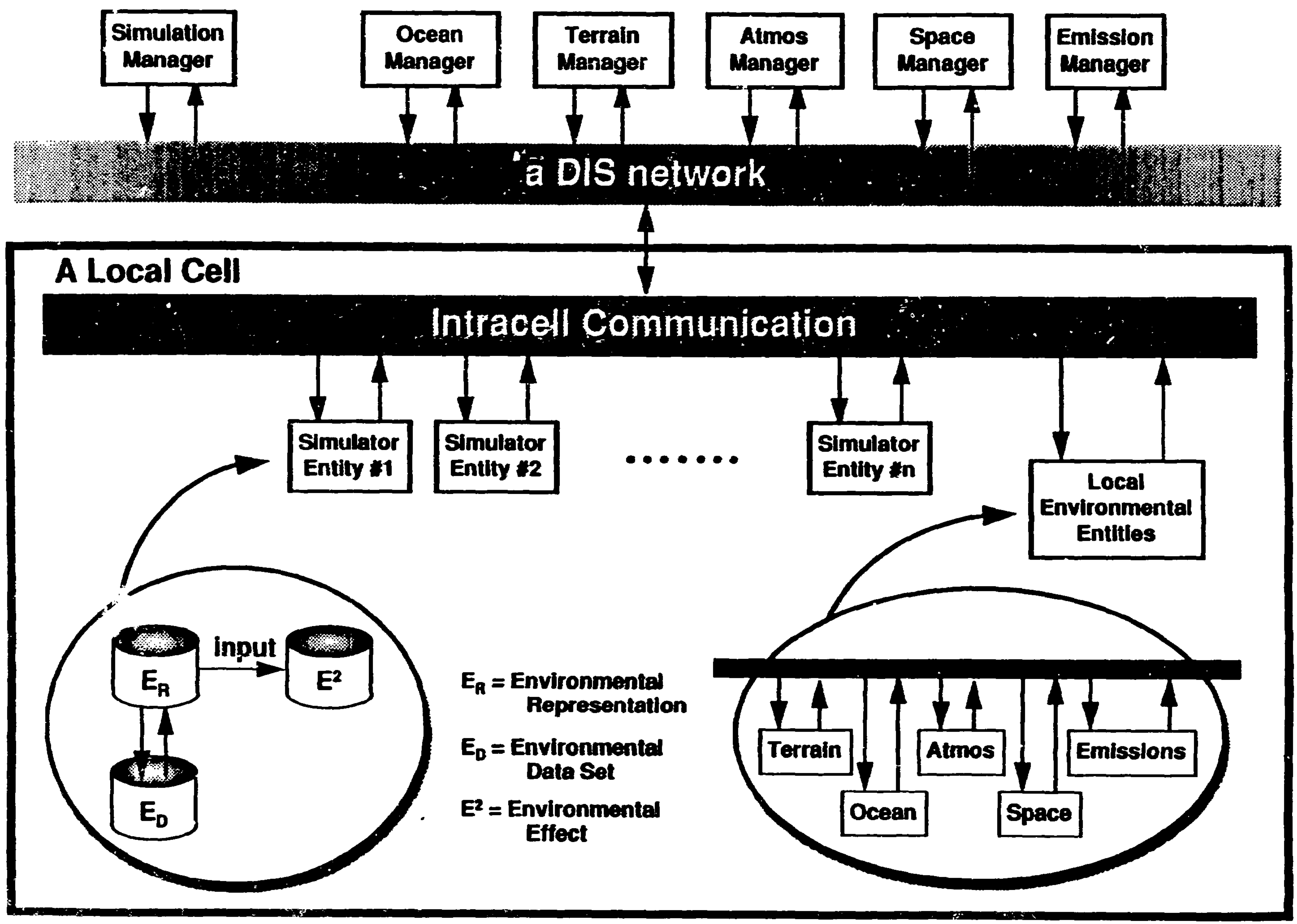
~~Demonstration~~

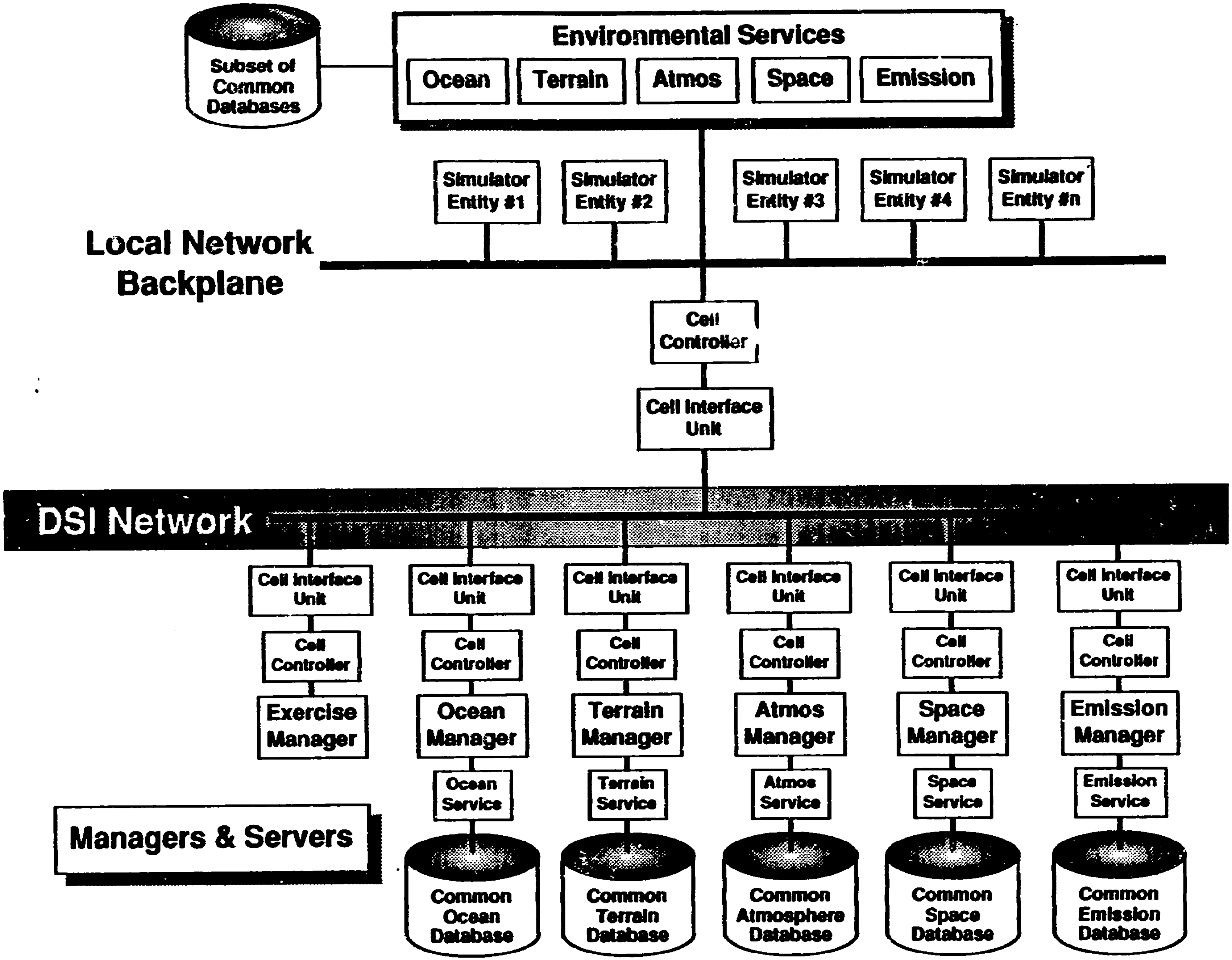
Prototyping & Experimentation

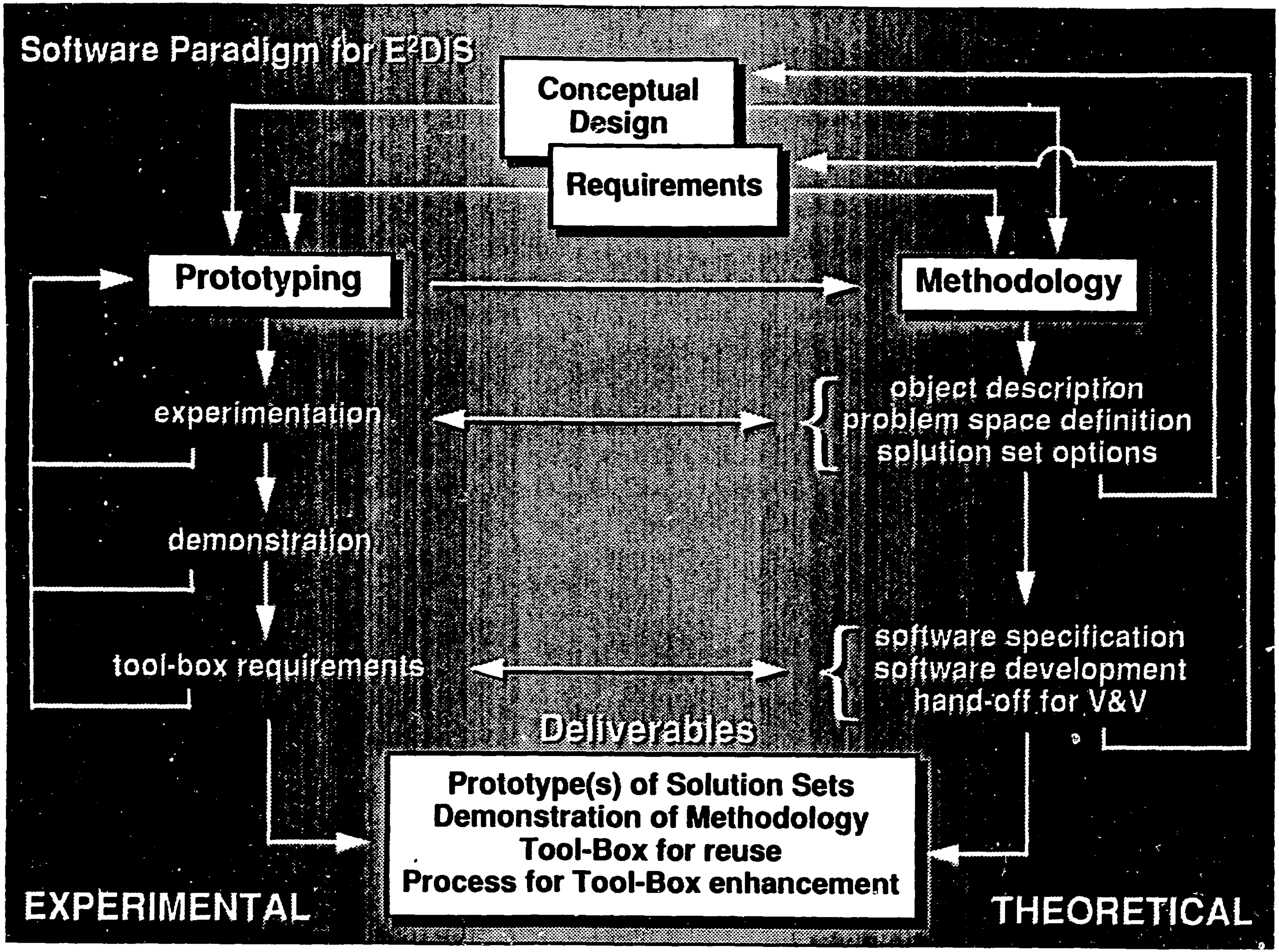
Enable rapid prototyping of design alternatives that appear to satisfy the E²DIS paradigm. Plan and conduct demonstrations of the effects of realistic synthetic environments on weapon system performance to show the achievement of significant E²DIS goals and to test & evaluate the E²DIS methodology.

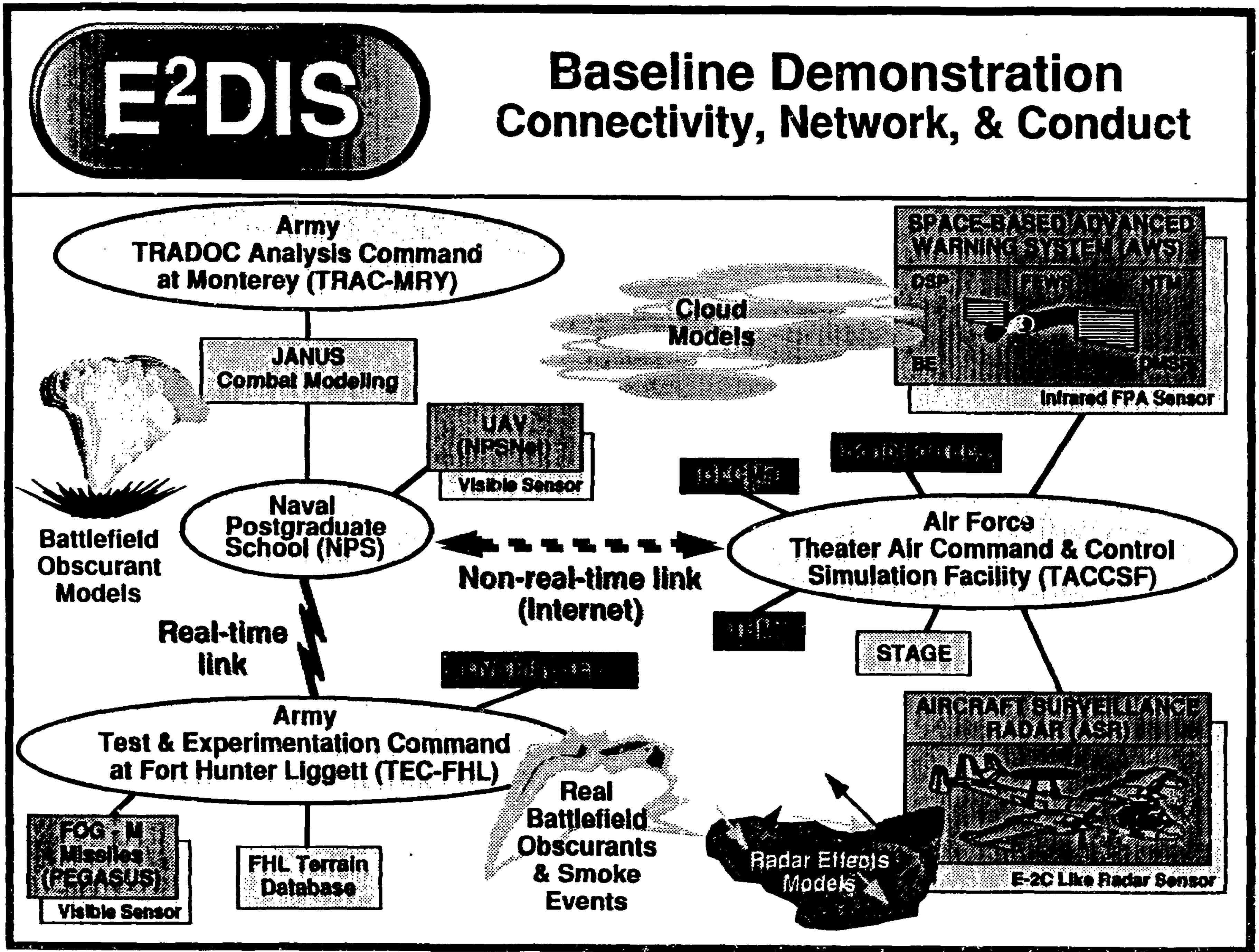
E&E² in Constructive Simulations

Develop a method to predict atmospheric environmental effects on the performance of weapons, sensors, and systems as portrayed in constructive simulations. The task will develop the FASTPROP software tool to provide an integrated capability for generating & rendering representative weather conditions in DIS compatible format and to provide the means to assess the impact of the atmospheric environment on signature prediction.


Simulation Manager
Ocean Manager
Terrain Manager
Atmos Manager
Space Manager
Emission Manager
a DIS network
A Local Cell
Intracell Communication
Simulator Entity #1
Simulator Entity #2
Simulator Entity #n
Local Environmental Entities
E_R
input
E^2
E_D
E_R = Environmental Representation
E_D = Environmental Data Set
E^2 = Environmental Effect
Terrain
Ocean
Atmos
Space
Emissions


Environmental Services
Ocean
Terrain
Atmos
Space
Emission
Subset of Common Databases
Simulator Entity #1
Simulator Entity #2
Simulator Entity #3
Simulator Entity #4
Simulator Entity #n
Local Network Backplane
Cell Controller
Cell Interface Unit
DSI Network
Cell Interface Unit
Cell Controller
Exercise Manager
Cell Interface Unit
Cell Controller
Ocean Manager
Ocean Service
Common Ocean Database
Cell Interface Unit
Cell Controller
Terrain Manager
Terrain Service
Common Terrain Database
Cell Interface Unit
Cell Controller
Atmos Manager
Atmos Service
Common Atmosphere Database
Cell Interface Unit
Cell Controller
Space Manager
Space Service
Common Space Database
Cell Interface Unit
Cell Controller
Emission Manager
Emission Service
Common Emission Database
Managers & Servers


Software Paradigm for E²DIS
Conceptual Design
Requirements
Prototyping
Methodology
experimentation
demonstration
tool-box requirements
object description
problem space definition
solution set options
software specification
software development
hand-off for V&V
Deliverables
Prototype(s) of Solution Sets
Demonstration of Methodology
Tool-Box for reuse
Process for Tool-Box enhancement
EXPERIMENTAL
THEORETICAL


E2DIS
Baseline Demonstration
Connectivity, Network, & Conduct
Army
TRADOC Analysis Command
at Monterey (TRAC-MRY)
JANUS
Combat Modeling
Battlefield
Obscurant
Models
Naval
Postgraduate
School (NPS)
UAV
(NPSNet)
Visible Sensor
Cloud
Models
SPACE-BASED/ADVANCED
WARNING SYSTEM (AWS)
DSP
FEWS
NTH
BE
DMSP
Infrared FPA Sensor
Non-real-time link
(Internet)
Air Force
Theater Air Command & Control
Simulation Facility (TACCSF)
STAGE
Real-time
link
Army
Test & Experimentation Command
at Fort Hunter Liggett (TEC-FHL)
FOG - M
Missiles
(PEGASUS)
Visible Sensor
FHL Terrain
Database
Real
Battlefield
Obscurants
& Smoke
Events
Radar Effects
Models
AIRCRAFT SURVEILLANCE
RADAR (ASR)
E-2C Like Radar Sensor

HMH:94-07-12

E^2DIS — Project Document (Table of Contents)

- 1.0 Introduction
- 2.0 Requirements
- 3.0 Conceptual Design
- 4.0 Engineering Design
- 5.0 Demonstration of Instantiation
- 6.0 Lessons Learned

3.1.0 System Object Description
- 3.1.1 Problem (Universe) Description
- 3.1.2 Description of Aggregate of Objects (objects & their behaviors)
- 3.1.3 Object Description and Functionality

3.2.0 Object Distribution Options
- 3.2.1 Environment on a Single Node serving n Nodes
- 3.2.2 Environment on all n Nodes
- 3.2.3 Environment Distributed over n Nodes
- 3.2.4 Environment sub-models distributed to n nodes

3.3.0 Connectivity & Communications
- 3.3.1 Interactions
- 3.3.1 Interfaces

3.4.0 Control of Objects
- 3.4.1 Initialization
- 3.4.2 Graceful Degradation
- 3.4.3 Communications Filtering
- 3.4.4 Control Architecture

3.5.0 Synchronization
- 3.5.1 Asynchronous
- 3.5.2 Synchronous
- 3.5.3 Time vs. Event
- 3.5.4 Rollback

3.6.0 Test & Evaluation
- 3.6.1 Requirements
- 3.6.2 Use Case
- 3.6.2 Experiments (Instantiations of Use Case)

E^2DIS — Verification & Validation

- *Verification*
  - —Verification of each E^2DIS experiment depends on the development of a conceptual model
  - —The Conceptual Model contains:
    - All entity constraints, requirements and specifications
    - Entity behavior
    - Interactions and interfaces between entities for constructive, live, and virtual parts of each experiment
  - —Verification will be accomplished in two parts:
    - Verify implementation of experiment by comparison with conceptual model
    - Confirm that the dynamic behavior of the experiment, as it is run, is as expected
- *Validation*
  - —Validation of each E^2DIS experiment relies on stating hypotheses of a quantitative statistical nature to be validated or invalidated by the results of the experiment
    - E^2DIS experiments are designed to test hypotheses through measurement of quantities associated with the response of the DIS system or simulation entities during the experiment and subsequent comparison of these quantities with the stated hypotheses
    - Analysis of EDIS experiments is an integral part of the experimentation activities and is used to validate hypotheses. Analysis is also used to evaluate the dynamical behavior of a conceptual model.

E^{2}DIS

General Requirements & Characteristics for 4D Database

- **Requirements**
  - —Provides fundamental environmental data for modeling and simulation
  - —Provides consistent data for environmental effects models
  - —Provides standardized database for system performance analysis
  - —Provide a set of standard synthetic natural environments
- **Characteristics**
  - —Consists of basic measurable parameters from which E^2 can be calculated
  - —Must maintain temporal continuity
  - —Consists of Land, Sea, Air, and Space data that is physically consistent across the boundaries of these domains
  - —Must be scalable, *i.e.*, maintains integrity from micro to global scales
  - —Verified /validated & certified to be a sufficiently faithful representation of the state of the environment based on current knowledge and simulation requirements
  - —Must be Object-Oriented

E^{2}DIS

Requirements & Characteristics for 4D Database specific to evolving E^{2}DIS "Use Case"

- At this time, E^{2}DIS requires two distinct databases for initial analysis, solution, and implementation of both the E^2 and the E_R problem:
  - —Atmosphere
  - —Terrain
- E^{2}DIS must address the registration issue at the database boundaries:
  - —Atmosphere and Land
  - —Atmosphere and Ocean Surface
  - —Land and Ocean Surface
- Certification of the data embedded in these databases is currently a secondary consideration, with the following caveat:

  Integration of "live play" into any scenario requires registration of the virtual and actual terrain, atmosphere, and ocean surface.
- The major E^2 and E_R problem focuses upon our understanding and ability to integrate these effects and representations using presently available models, simulators, and simulations.
  - —Once we have solved this problem, we will be able to use any consistent database within our paradigm, regardless of the veracity of that database.
  - —Our intent is to gather data appropriate to the EDIS Use Case, not to certify it.

E²DIS

Object-Oriented Database Design

- The basic principal of O-O database design is the layered interface that allows the user to specify the input & output to a database without concern for the implementation, *i.e.*, the non-computer scientist defines the I/O *requirements* for database access.
- An O-O design provides for *information hiding* allowing different users to have different views of the same data.
  - —Different users see their own interface without knowledge of another's.
  - —A layered interface makes the database implementation invisible to the user.
  - —*Any* database design could be used without the user having to learn a new access method, or even be aware of the change.
  - —No code changes (for the user) would be necessary.

An example of the efficacy of this approach lies in the difficulty most users have in setting up and accessing relational databases. Because of the complexity of the process, the setup and access to relational databases is often highly inefficient, not taking advantage of the paradigm because of lack of time and understanding. An O-O method would allow expert design invisible to the user, while the user defines the requirements.

E²DIS

Database Scalability

- The database must allow for upward and downward scaling to address the granularity needs of all models accessing the database.
  - —The database, itself, does not do the scaling. This is an issue for the algorithms that manipulate the data, not the structure of the database. A needs analysis will determine the scaling requirements for E²DIS.
- Scalability refers not only to the parameters contained in each 4D cell, but to the granularity of the 4D access points within the database. The space-time continuum can be assumed to be linearly continuous if the 4D steps are sufficiently small.

E²DIS

E^2DIS Task Area 2
Standards

- Requirements for Standard Databases, Data Structures & Transfer Formats
  - Needed to facilitate transfer of information on the synthetic physical environments used in distributed simulations
  - Implementation on wide range of computers using COTS or GOTS software
  - Coordination with existing DoD efforts at standardization and submission to an appropriate DoD approval process such as the Corporate Information Management (CIM) system
  - Environmental PDU enumeration tables are required
- Approach
  - Adopt/Adapt where possible prevailing standards
- Deliverables
  - Standard transfer formats, definition of DBMS requirements, survey of government database systems
  - Methodologies to put some E_n and E^2 into standard form to support Use Case
  - Environmental PDU enumeration methodology

E²DIS

E^2DIS Task Area 2
Standards
Sub-tasks

- Develop/Adopt Standard Transfer Format(s)
  - GRIB, Gridded Binary,
    World Meteorological Organization (WMO)
  - BUFR, Binary Universal Form for the Representation of meteorological data,
    World Meteorological Organization (WMO)
  - HDF, Hierarchical Data Format,
    National Center for Supercomputing Applications (NCSA)
  - CDF, Common Data Format,
    National Aeronautics & Space Administration (NASA)
  - DEF, Data Exchange Format,
    Communications Interface for Data Exchange used by DoD & DoC
  - TIFF, Tagged Image File Format,
    Serveral versions in public domain
  - FITS, Flexible Image Transport System,
    International Astronomical Union standard
  - FIPS, Spatial Data Transfer Standard (FIPS 173)
- Develop Methodologies to put E_n & E^2 Information into Standard Format
- Develop Methodology to Provide Environmental PDU Enumeration Tables

E²DIS Task Area 3
Environmental Representations

- Requirements
  - Facilitate the creation and representation of realistic synthetic environments for terrain, ocean, atmosphere, and near-space
  - Ensure treatment for E² retains inherent temporal and spatial variability
  - Ensure representation is scalable to constraints/capabilities of different simulators
- Approach
  - Develop methodologies and procedures to deal with numerical environmental databases and feature models (put database or model output into standard form)
  - Develop methodologies to combine outputs from environmental models & databases and feature models into a single environmental representation
  - Cooperate with other related projects, such as the Master Environmental Library (MEL), to provide oceanographic E_N to broaden the scope of the E²DIS Use Case
- Deliverables
  - Documentation of environmental models for producing E_N databases and means to obtain source code and/or algorithms
  - Selected prototypical feature models for the atmosphere and near space
  - Methodologies to combine outputs from numeric & feature models
  - Initial set of synthetic environments for the atmosphere & near space
  - A DMA compliant general terrain model and a PEGASUS terrain model (the latter to support visual, IR, and RF inputs for sensor simulators)

E²DIS Task Area 3
Environmental Representations
Sub-tasks

- Atmospheric Environmental Representations
  - Convert selected existing gridded E_N databases into standard transfer formats
  - Create atmospheric representations using selected models
    - NORAPS and COAMPS from NRL-MRY
    - WAVES, COMBIC, and STATBIC from ARL/BED
    - CSSM from PL/GP
  - Identify, use numerical & parametric feature models for improved resolution
  - Combine outputs from E_N databases with higher resolution feature models
- Near Space and Upper Air Environmental Representations
  - Use first-principles and engineering level models to generate databases that include earth's radiation belts, ionosphere, magnetosphere
    - WBMOD, CRRESRAD, 3D Ray Trace, IAPIM and PIM from PL/GP
- Terrain Environmental Representations
  - Integrate atmospheric objects (fog, dust, smoke, clouds) into terrain
  - Transfer PEGASUS database from transputer system to SGI ONYX
  - Register multi-spectral databases to DMA DTED
  - Integrate dynamic terrain models into the terrain representation software
  - Register radar clutter database with terrain database
  - Evaluate different visualization software

E²DIS Task Area 4
Environmental Effects & Processes

- **Requirement**
  - The requirement is to select, modify, or create and to integrate high-fidelity, physics-based environmental effects models into E²DIS
- **Approach**
  - Integrate terrain databases for the Fort Hunter-Liggett (FHL) canonical site into E²DIS
  - Integrate Visual/IR/RF models to account for emission, scattering, propagation, and attenuation of radiation, validate using FHL field data
  - Add treatment for obscurants
- **Deliverables**
  - High-fidelity, physics-based environmental (*e.g.*, terrain/atmospheric) effects models adapted to operate in conjunction with the E²DIS terrain model
  - Set of terrain (visual & thermal) databases for the FHL validation site
  - Validation reports for environmental effects models
  - Software & database users guide

E²DIS Task Area 4
Environmental Effects & Processes
Sub-tasks

- Integration of *terrain model*, and associated high fidelity visual & thermal databases, that describes the Fort Hunter-Liggett (FHL) canonical site
- Verification & integration of EO/IR terrain background model
  - Verification of model using FHL test data
  - Verification of model using IR seeker model
  - Integration of model into E²DIS architecture
- Integration of existing *visual & IR emission, scattering, and propagation models* into E²DIS architecture and validation using field data collected at FHL
- Integration of existing *RF clutter, multipath, and attenuation models* into E²DIS architecture and validation using field data collected at FHL
- Integration of existing *obscurant models* (*e.g.*, smoke, dust, chaff) into E²DIS architecture

E²DIS Deliverables

- E²DIS Prototype:
  - Several experiments implemented in code and demonstrated
  - Complete documentation of experimental process & lessons learned
  - Complete documentation of components, databases, interfaces, communications (e.g., DIS messages, protocols; configuration; non-DIS protocols)
- E²DIS Methodology:
  - OOA, OOD
  - Conceptual Design Document
  - Requirements Document
  - Interface Document
  - Database Descriptions
- E²DIS Tool-box:
  - Several Tools (Environmental Cell Manager, Environmental Data Ingestor, Object-Oriented Database)
  - Requirements
  - Component Functional Description
  - Component Interface Description
  - Design Document
  - User Document

E²DIS Status

- Multiple solutions are being tested and are expected to be viable
- Methodology being developed is extensible and robust
- Prototype will provide tool requirements and verification; Methodology will provide tool development
- Interaction with Master Environmental Library (MEL) program will provide standard data sets
- 4D Environmental Databases for atmosphere and terrain will be developed using an object oriented paradigm

E²DIS

Recent Publications
Appearing in Conference Proceedings

An Object-oriented Technology for Integrating Environmental Effects and Distributed Simulations

Frederick Wieland
Harry Heckathorn
Naval Research Laboratory
Washington, D.C.

Introduction

DIS and Environmental Effects

O-O Simulation Conf.
January 1994

IRIS TBD Conf.
February 1994

Approved for public release; distribut

ENVIRONMENTAL EFFECTS
FOR
DISTRIBUTED INTERACTIVE SIMULATION (E²DIS)

Harry Heckathorn
Naval Research Laboratory
Washington, DC 20375

February 1994

ABSTRACT

Towards Realistic Environmental Effects
In Distributed Interactive Simulation

Harry Heckathorn
Naval Research Laboratory
Washington, DC 20375-5352

Richard K. de Jonckheere
Phillips Laboratory
Kirtland AFB, NM 87117-6008

Stan Grigsby
Technautics, Inc.
Arlington, VA 22202-3742

ABSTRACT

I. INTRODUCTION

Test Technology Symp.
March 1994

HMH:94-07-12

Office of Strategic Phenomena Projects for BMDO

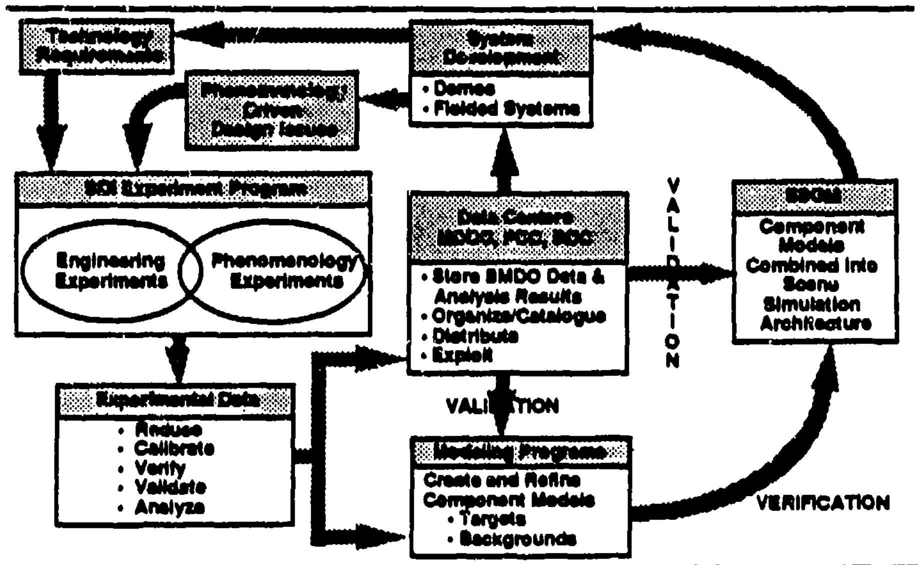
BMDO Synthetic Scene Generation Model (SSGM): The standard BMD modeling tool for generating multi-phenomenology, synthetic imagery data relating to strategic backgrounds and targets

- Natural & Man-made Backgrounds
  - Terrestrial (terrain, ocean, ocean ice)
  - Clouds
  - Atmospheric (emission, absorption, scattering)
  - Aurora
  - Celestial (zodiacal, planetary, galactic, extragalactic)
  - Nuclear (background effects and environments)
- Targets
  - Boosting missiles, post-boost vehicles, reentry vehicles, satellites
  - Target related phenomena (impact debris, decoys, fuel vents)

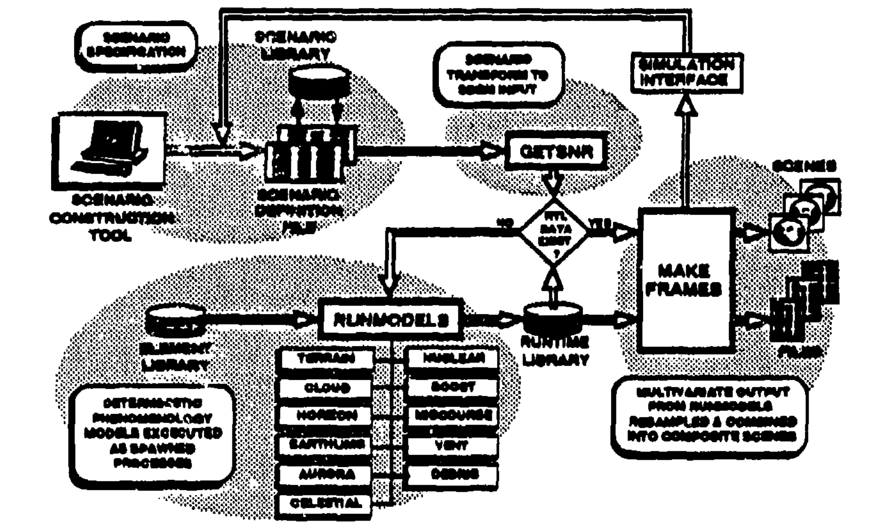
BMDO Backgrounds Data Center (BDC): Phenomenology data center for BMD experimental products relating to terrestrial, atmospheric, and celestial backgrounds

- Archive, catalogue, maintain, control, and distribute background data sets
- Processing & analysis support to BMD research community

BMDO Phenomenology Program Structure
Management of Experimental & Modeled Data



SSGM Functional Flow



SSGM Phenomenology Models (Natural Elements)

CATEGORY	OBSERVABLE	MODEL	DESCRIPTION	AGENCY & DEVELOPER
TERRESTRIAL	Hard Earth	■ GENESIS	Terrain Scenes (Rad.)	NRL/PRA
	Cloud	■ CLDSIM	Cloud Scenes (Rad. & Trans.)	NRL/PRA
EARTH LIMB	LTE Atmosphere	■ MODTRAN	LTE Band Model (Rad. & Trans.)	PL
	LTE Atmosphere	■ APART	Propagation and Radiative Transport	PL/NRL/PRA
	LTE Atmosphere	■ MOSART 1.0	MODTRAN & APART	PL/PRA
	NLTE Limb	■ SHARC 2.1	NLTE (Rad.)	PL
	NLTE Limb	■ SHARC 3.0	NLTE (Rad.)	PL
	LTE/NLTE	■ SAMM 1.0	SHARC & MODTRAN Merged	PL
	Atmospheres	■ SAG	SAMM Atmosphere Generator	PL
	LTE/NLTE	db FASTLIMB	Earthlimb Spectral Radiance Data Base (2-30 mm in 1% energy bins) derived from MODTRAN & SHARC	PL/MRC
AURORA	Perturbed Limb	db AURORA	Aurora Volumetric Emission Spectral Data Base (2-30 mm at 1 cm^{-1} resolution) derived from ARCTIC, M81190, PRISM, ARCHON, NLTE, DOUBPI & SINGLET	MRC/PL/DNA
SPACE	Celestial Phenomena	■ CBSD	Celestial Background Scene Descriptor	PL/MRC
		■ CBPOINTS	Point Source Galactic Stars	PL/NASA/MRC
		■ CBZODY	Zodiacal Background (Diffuse & Structured)	PL/MRC
		■ CBAMP	Asteroids, Moons, Planets, & Sun	PL/MRC
		CBCIRRUS	Infrared Galactic Cirrus Background	PL/MRC

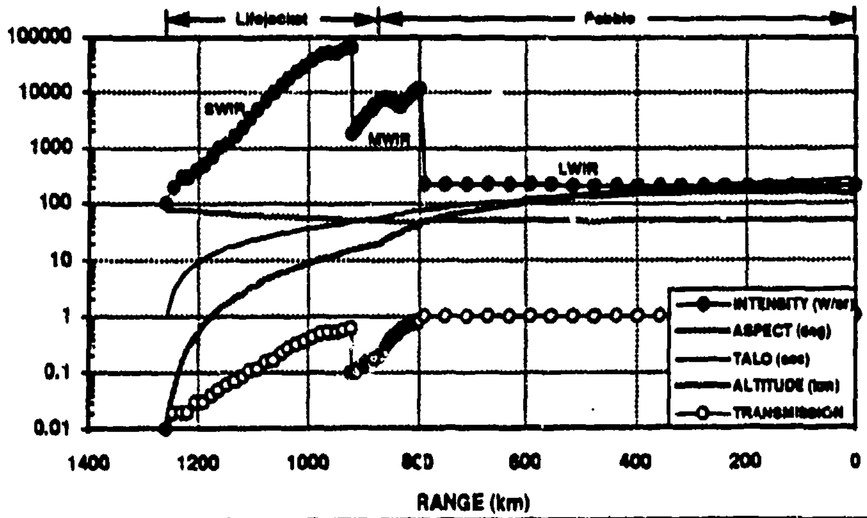
■ On-line SSGMB R6.0
db Calculated data base

SSGM Phenomenology Models (Man-made Elements)

CATEGORY	OBSERVABLE	MODEL	DESCRIPTION	AGENCY & DEVELOPER
TARGET	Missile Plume	■ SIRRM II	Plume Radiance for 2D/3D Geometries (used in SSGM for altitudes <50 km)	PL/MICOM, GAC, SSI
		■ SIRRM III	Plume Radiance for 3D/3D Geometries	PL/MICOM, GAC, SSI
		db SPF3	Couples Missile Body, Base, & Flowfield	PL/MICOM, PST
		■ CHARM 1.3	Plume Flowfield & Radiance (used in SSGM for altitudes >50 km)	PL/LMSC, SSI, AOI, CALSPAN, GAC
	Plume Transients	SFM	Plume Flowfield & Transients (staging, chuffing, thrust vector control)	PL/SEA, AOI
	Debris	■ DEBRA/KIDD	Debris from KKV intercepts	PL+SSDC+SMC/Aerospace
	Post-Boost Vehicle	CHAMP	PBV Hardbody & Plumes	PL+WL/AOI
	Plume Illumination	HALT	Plume/Laser Retroreflectance	PL
	Target Illumination	DELTAS	Target/Laser Retroreflectance	BMDO/NRC
	Target Hard Body	db OSC XVIII	Optical Signatures Code Target Database	SSDC/TBE
		■ OPTISIG	Point Image Signature Generation Code	SSDC/TBE
		■ MCOSIG	Exoatmospheric Signatures and Resolved Images	NRL/TBE
		■ NDOSIG	Endoatmospheric Signatures and Resolved Images	NRL/TBE
		■ MCOIMG	Run-time resolved image capability	NRL/TBE
NUCLEAR	Perturbed Atmosphere	db NORSE	Analytic Application Code (Rad.)	DNA/VI, MRC
		■ PEM 3.3	Engagement Code (Rad.)	DNA/VI
		■ IRSim	Engagement Code (Rad.)	DNA/VI
		■ HISEMM	Engagement Code (Rad. & RF Prop.)	DNA+SSDC/VI

■ On-line SSGMB R6.0
db Calculated data base

BP Engagement of V4 Target
Radiometric/Geometric Values from SSGM



(John Harding)

29M

DMSO

Common Data Bases, Real World Data

MASTER ENVIRONMENTAL LIBRARY (MEL)

- DMSO FY 94 New Start
- Addresses M&S Infrastructure

DMSO (MEL)

Common Data Bases, Real World Data

RATIONALE

- M&S NEEDS REALISTIC OCEAN, ATMOSPHERE, AND NEAR SPACE ENVIRONMENT
  - NO STANDARD, HIGH RESOLUTION DATA BASES EXIST
- SERVICES & NOAA SHARE ACCESS TO LARGE SETS OF ENVIRONMENTAL OBSERVATIONS AND MODELS
  - NO STANDARD EXTRACTION METHODOLOGY NOR DoD LIBRARY APPLICABLE TO M&S EXISTS

DMSO (MEL)

Common Data Bases, Real World Data

LONG TERM VISION

- **ENVIRONMENTAL DATA LIBRARY**
  - General M&S Applicability
  - Multi-Service
  - Digital
  - Consistent from R&D through to Operations
  - Historical, Statistical, And 4-D Data

DMSO (MEL)

Common Data Bases, Real World Data

APPROACH

- SHORT TERM MEL
  - RAPID PROTOTYPE
    - Specific Customer Focus
    - SW U.S. - Year 1
    - SE U.S. - Year 2
- LONG TERM MEL
  - RECOMMEND ARCHITECTURE & CONTENTS

DMSO (MEL)

Common Data Bases, Real World Data

SPECIFIC TASKS

- Environmental Requirements
- Architecture
- Climatological & Fixed Data Bases
- Integrated Synthetic Scenarios
- Prototype Demonstration
- Prototype Evaluation
- Management & Integration

DMSO

COMMON DATA BASES, REAL WORLD DATA

TASK 1: ENVIRONMENTAL REQUIREMENTS

- IDENTIFY M&S ENVIRONMENTAL REQUIREMENTS AND DATA BASES
- RECOMMEND SAME FOR PROTOTYPE MEL
- RECOMMEND SAME FOR LONG-TERM MEL

DMSO

COMMON DATA BASES, REAL WORLD DATA

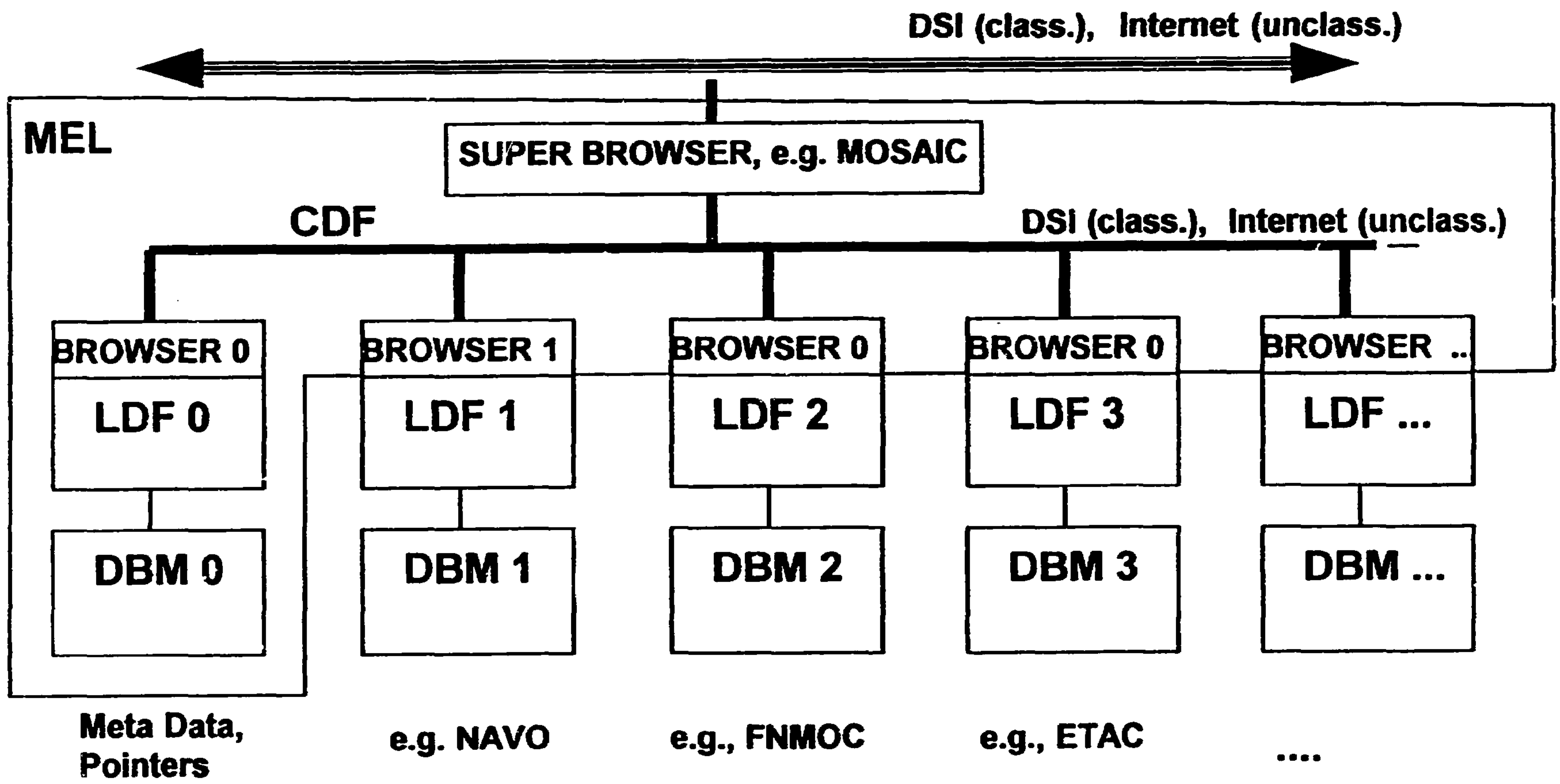
TASK 2: DATA BASE ARCHITECTURE

- IDENTIFY EXISTING AND PLANNED OPERATIONAL ARCHITECTURES
- SELECT/ADAPT/DEVELOP PROTOTYPE ARCHITECTURE AND DATA BASE/DATA INTERFACE
- RECOMMEND LONG-TERM ARCHITECTURE

DMSO (MEL)

Common Data Bases, Real World Data

CANDIDATE MEL ARCHITECTURE



C-LINE #62013
CLEAR TOPPER

(9)

Center for
Air
Sea
Technology

NEONS BROWSER©
(Touring the Database)

Select a Region
* rubber band
* keyboard entry
* predefined

Select One or more Data Types

Chooose Time Constraints

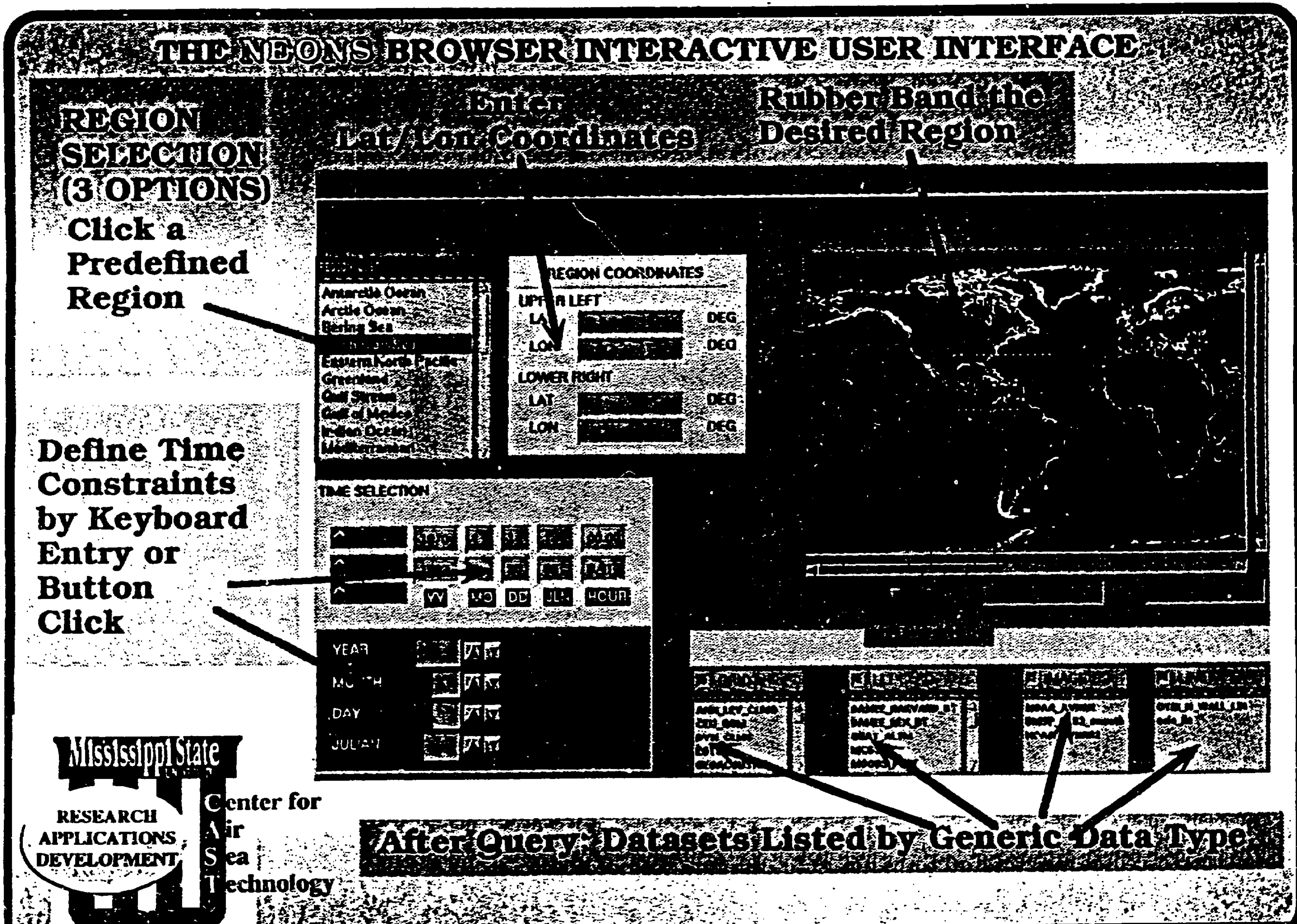
Search Database

List Datasets for each Selected Data Type

Select Dataset to Examine

Display Meta Data

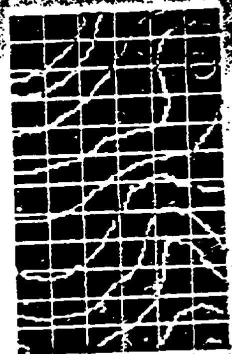
FEATURES
- Event Driven (interactive) GUI
- View Most Data in Graphical Form
- Save Region Specifications for Later Use (predefine)
- Export Data to a File
- Excellent Foundation for more Complex Applications


THE NEONS BROWSER INTERACTIVE USER INTERFACE
REGION SELECTION (3 OPTIONS)
Click a Predefined Region
Enter Lat/Lon Coordinates
Rubber Band the Desired Region
REGION COORDINATES
UPPER LEFT
LON
DEG
LOWER RIGHT
LAT
Antarctic Ocean
Arctic Ocean
Bering Sea
Define Time Constraints by Keyboard Entry or Button Click
TIME SELECTION
YY
DD
HOUR
YEAR
DAY
After Query: Datasets Listed by Generic Data Type
Mississippi State
RESEARCH APPLICATIONS DEVELOPMENT
Center for Air Sea Technology

Universal 21125

NEONS GENERIC ENVIRONMENTAL DATA TYPES MAKE LIFE EASIER FOR YOU

GRID



Model Output

Model Input

Matrices

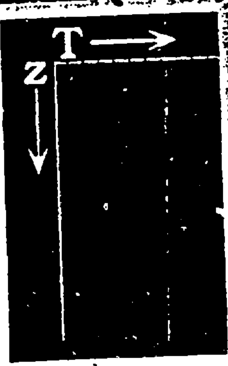
IMAGE

Satellite Imagery

Bitmaps

Displays

LATITUDE/ LONGITUDE/ TIME (LLT)

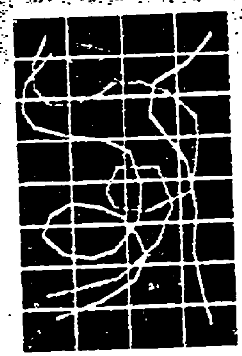


Bathythermograph

Radiosonde

Observation Reports

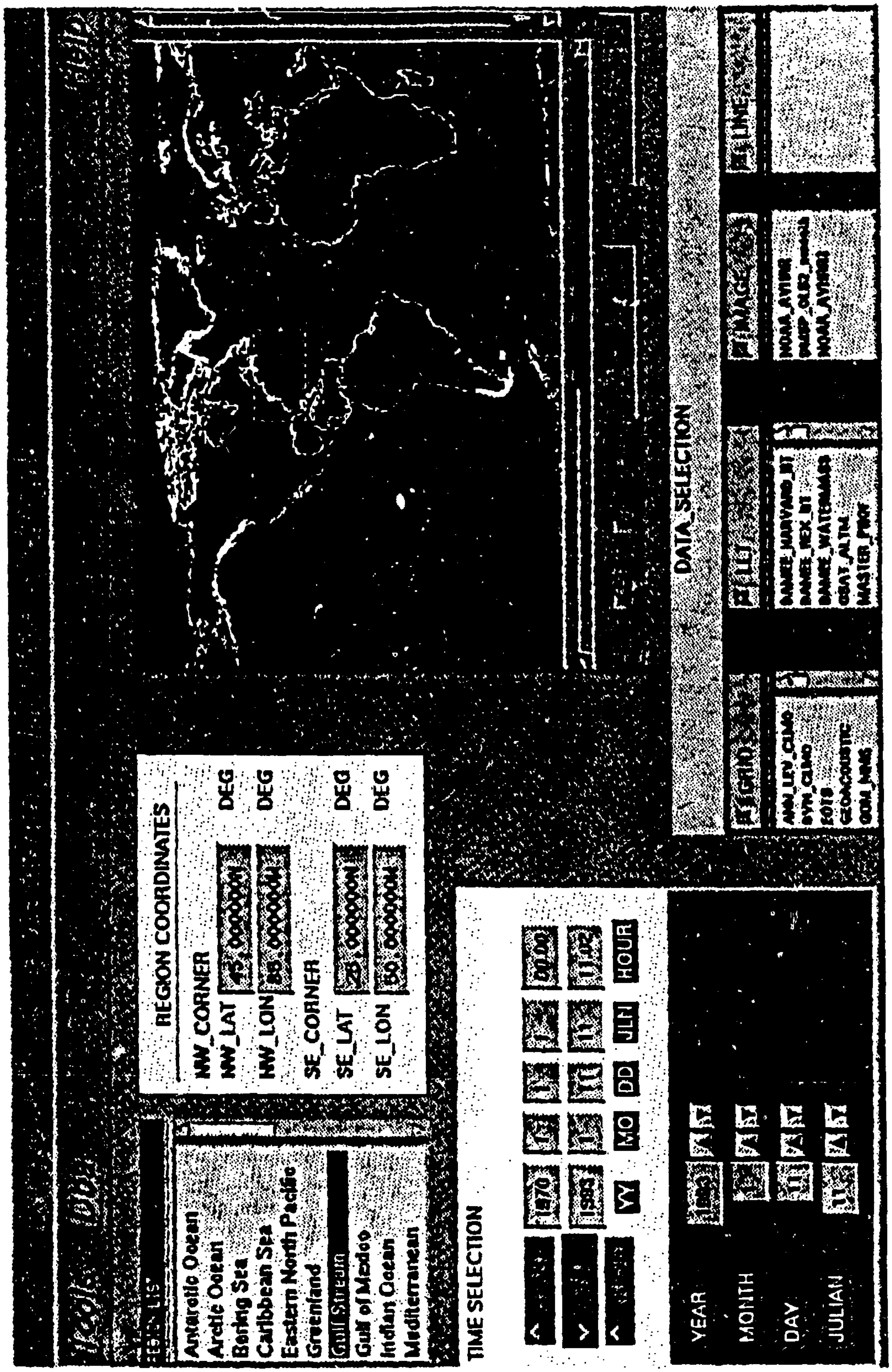
LINE



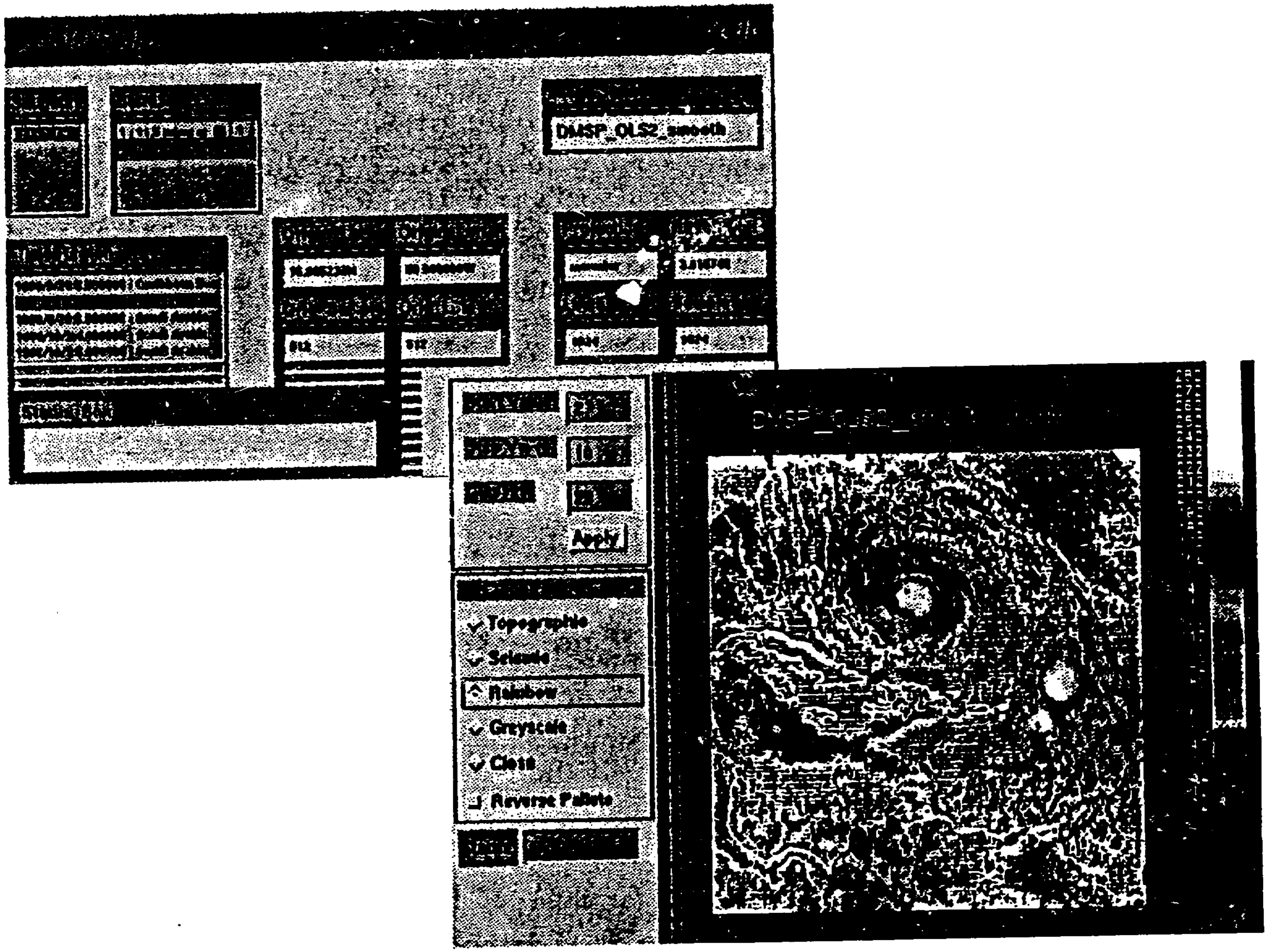
Ship Tracks

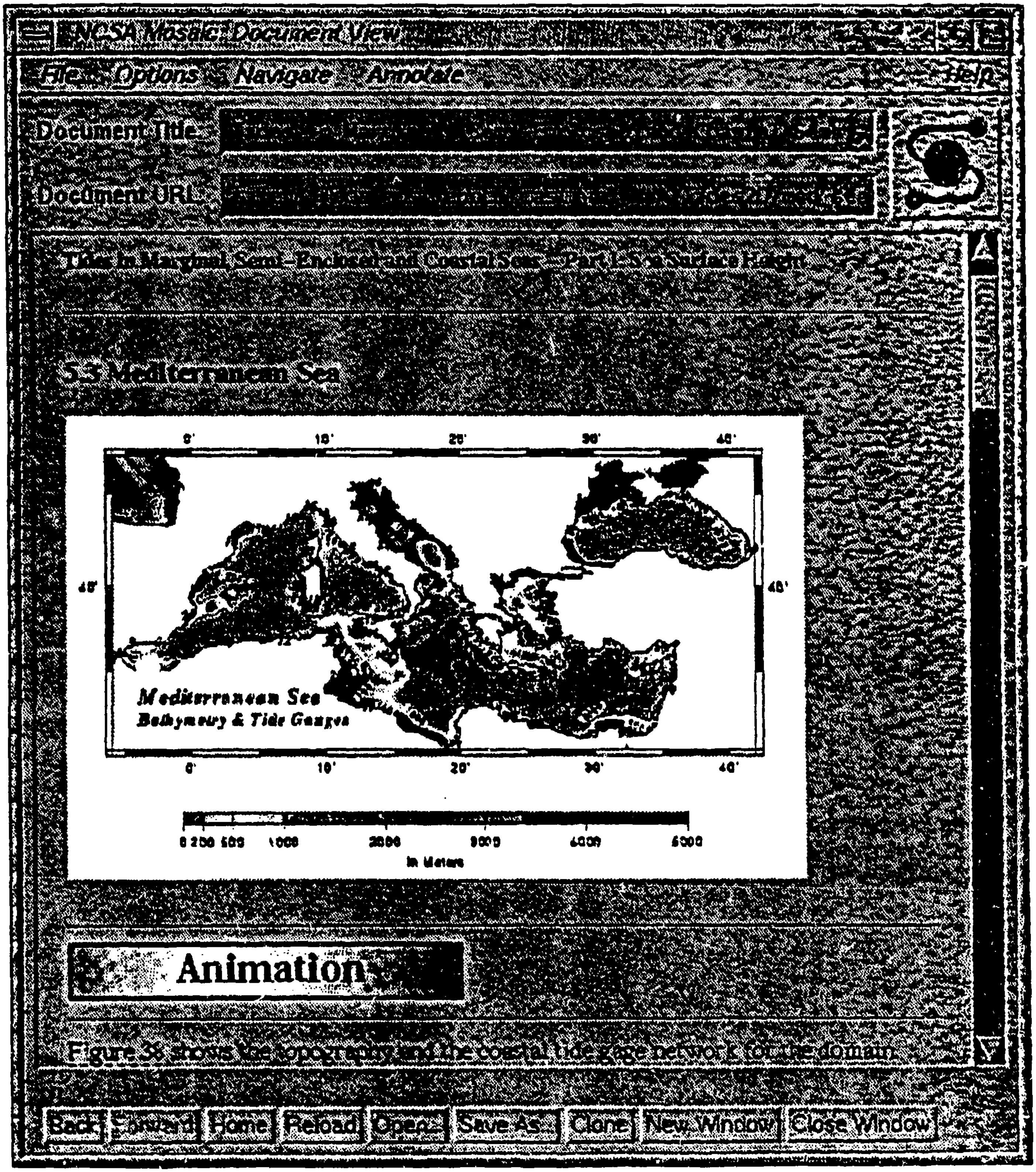
Buoy Tracks

Hurricane Tracks


Antarctic Ocean
Arctic Ocean
Bering Sea
Caribbean Sea
Eastern North Pacific
Greenland
Gulf Stream
Gulf of Mexico
Indian Ocean
Mediterranean
REGION COORDINATES
NW_CORNER
NW_LAT
DEG
NW_LON
DEG
SE_CORNER
SE_LAT
DEG
SE_LON
DEG
TIME SELECTION
YY
MO
DD
JLN
HOUR
YEAR
MONTH
DAY
JULIAN
DATA_SELECTION

NEONS Browser Image Data Displays




NCSA Mosaic: Document View
File Options Navigate Annotate Help
Document Title:
Document URL:
Tides in Marginal, Semi-Enclosed and Coastal Seas — Part I: Sea Surface Height
5.5 Mediterranean Sea
0° 10° 20° 30° 40°
40° 40°
Mediterranean Sea
Bathymetry & Tide Gauges
0 200 500 1000 2000 3000 4000 5000
In Meters
Animation
Figure 38 shows the topography and the coastal tide gage network for the domain
Back Forward Home Reload Open... Save As... Clone New Window Close Window

DMSO

COMMON DATA BASES, REAL WORLD DATA

TASK 3: CLIMATOLOGICAL & FIXED DATA BASES

- SELECT AND ACQUIRE INITIAL DATA BASES FOR PROTOTYPE
- POPULATE PROTOTYPE MEL

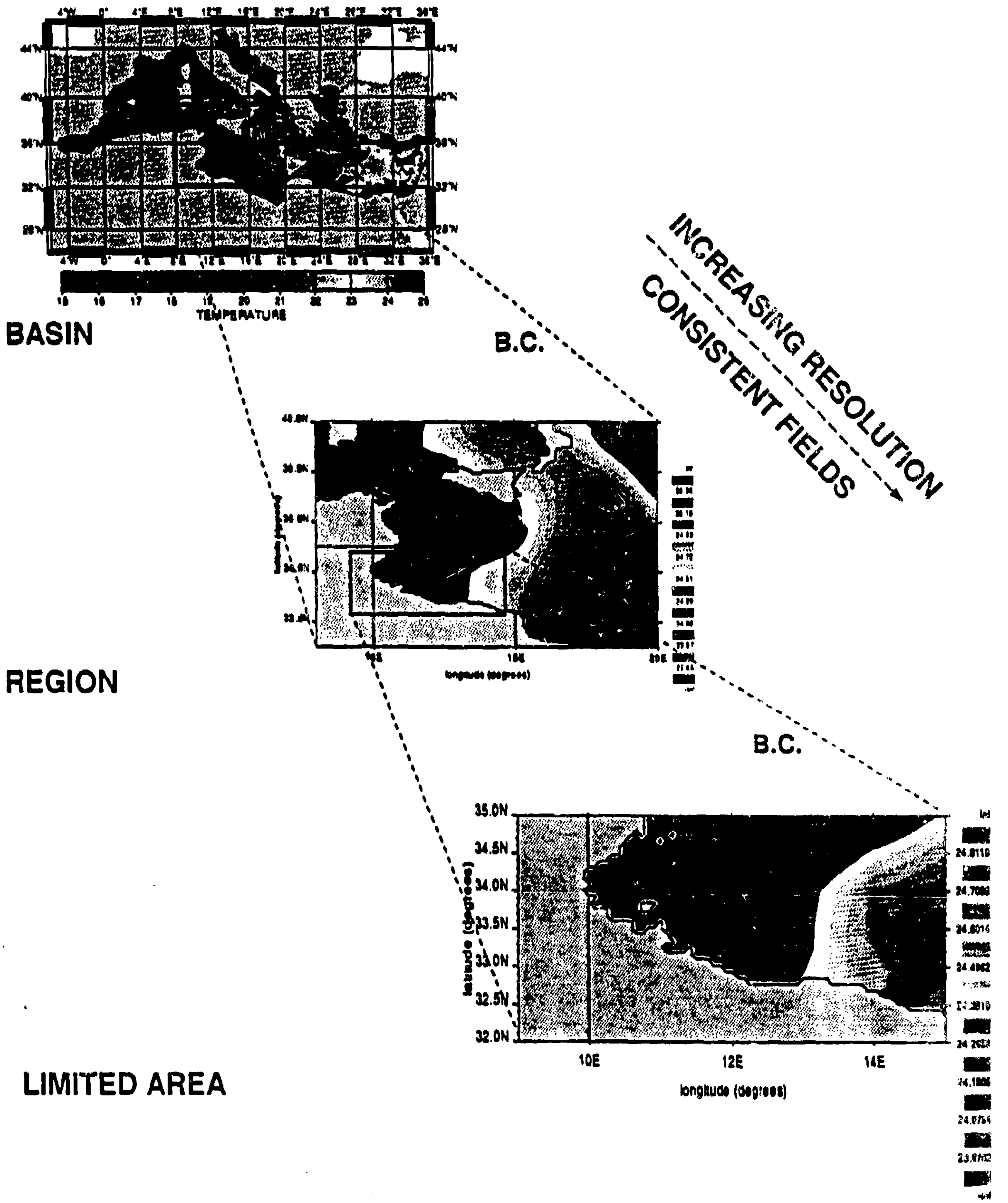
DMSO

COMMON DATA BASES, REAL WORLD DATA

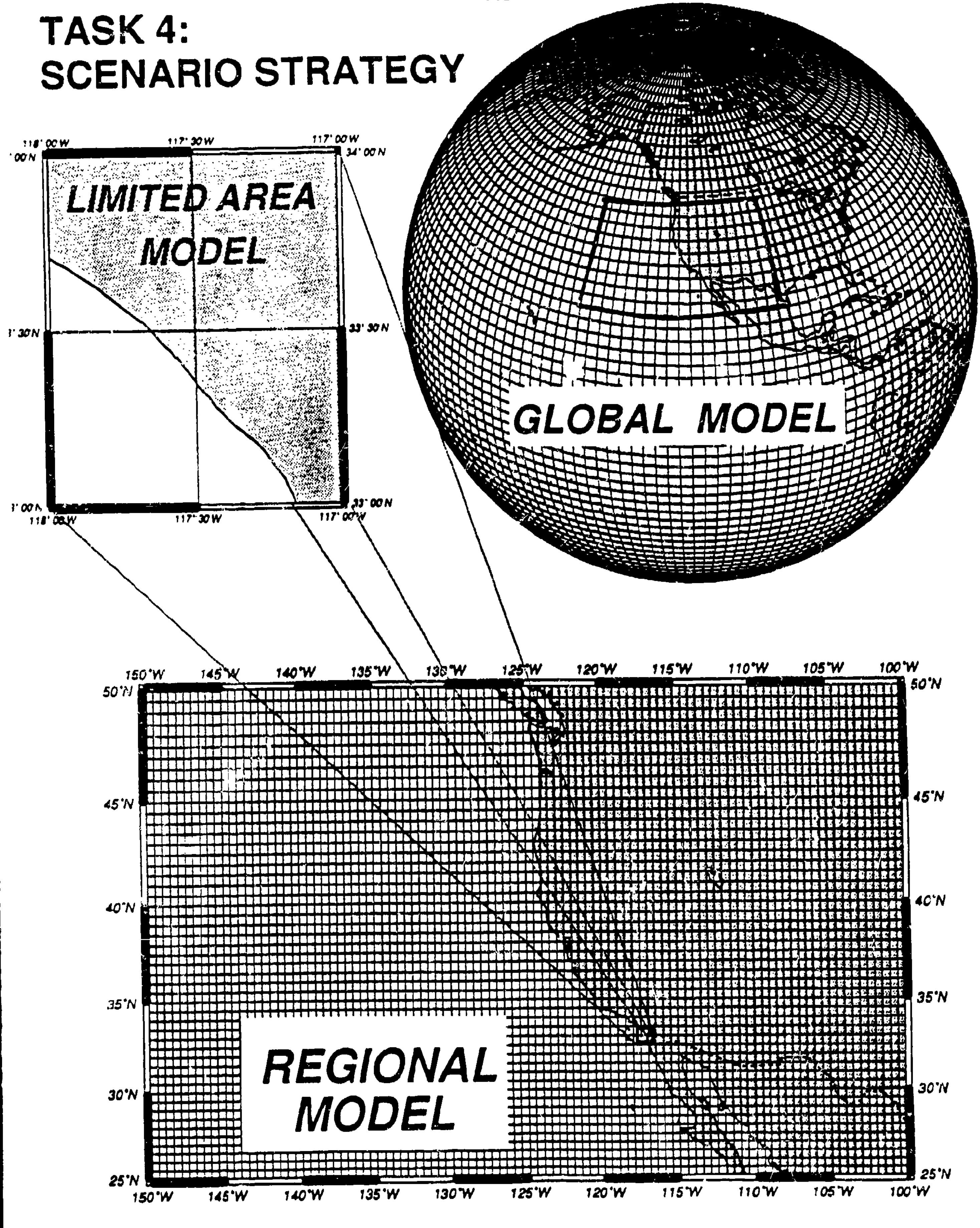
TASK 4: INTEGRATED SYNTHETIC SCENARIOS

- IDENTIFY M&S RELEVANT 4-D SCENARIOS
- SELECT AND ACQUIRE DATA/ MODELS TO CREATE PROTOTYPE SCENARIOS
- CREATE INTEGRATED ENVIRONMENTAL SCENARIOS
- POPULATE PROTOTYPE MEL

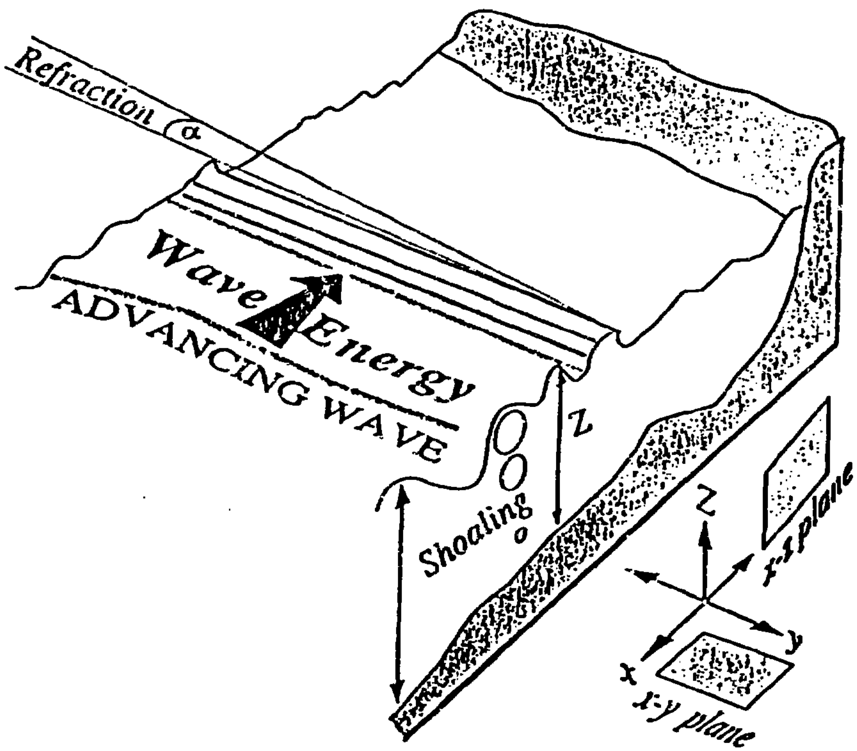
MEL SIMULATION STRATEGY



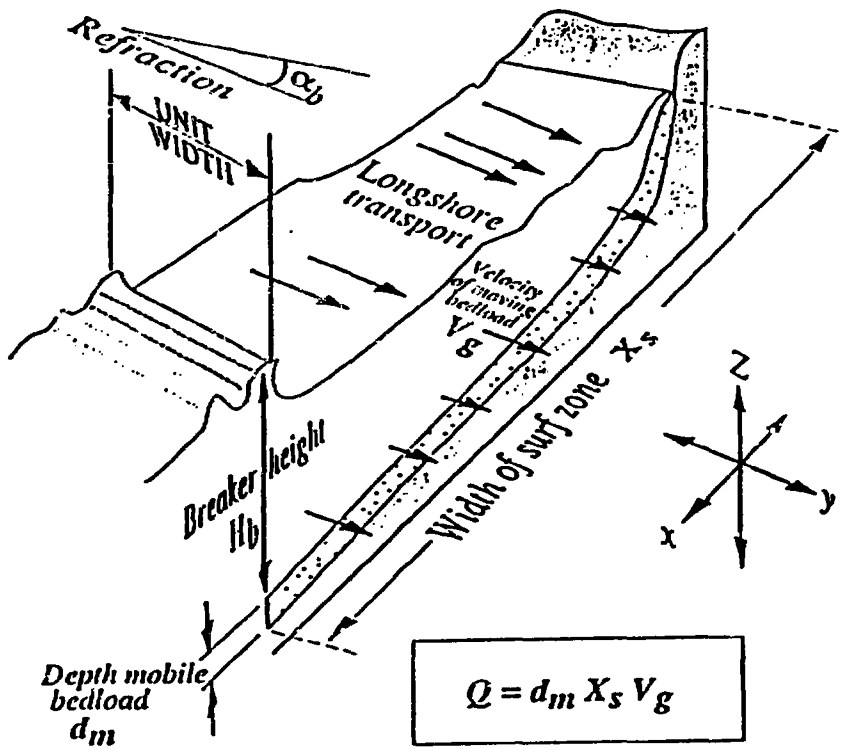
TASK 4: SCENARIO STRATEGY



PROJECT: NOMP Prediction of Surf and Beach Processes



Shoaling Wave Field



Surf Zone

DMSO

COMMON DATA BASES, REAL WORLD DATA

TASK 5: COMMON LIBRARY DEMONSTRATION

- DESIGN/PLAN/PREPARE DEMONSTRATIONS FOR PROTOTYPE MEL

- PERFORM DEMONSTRATIONS

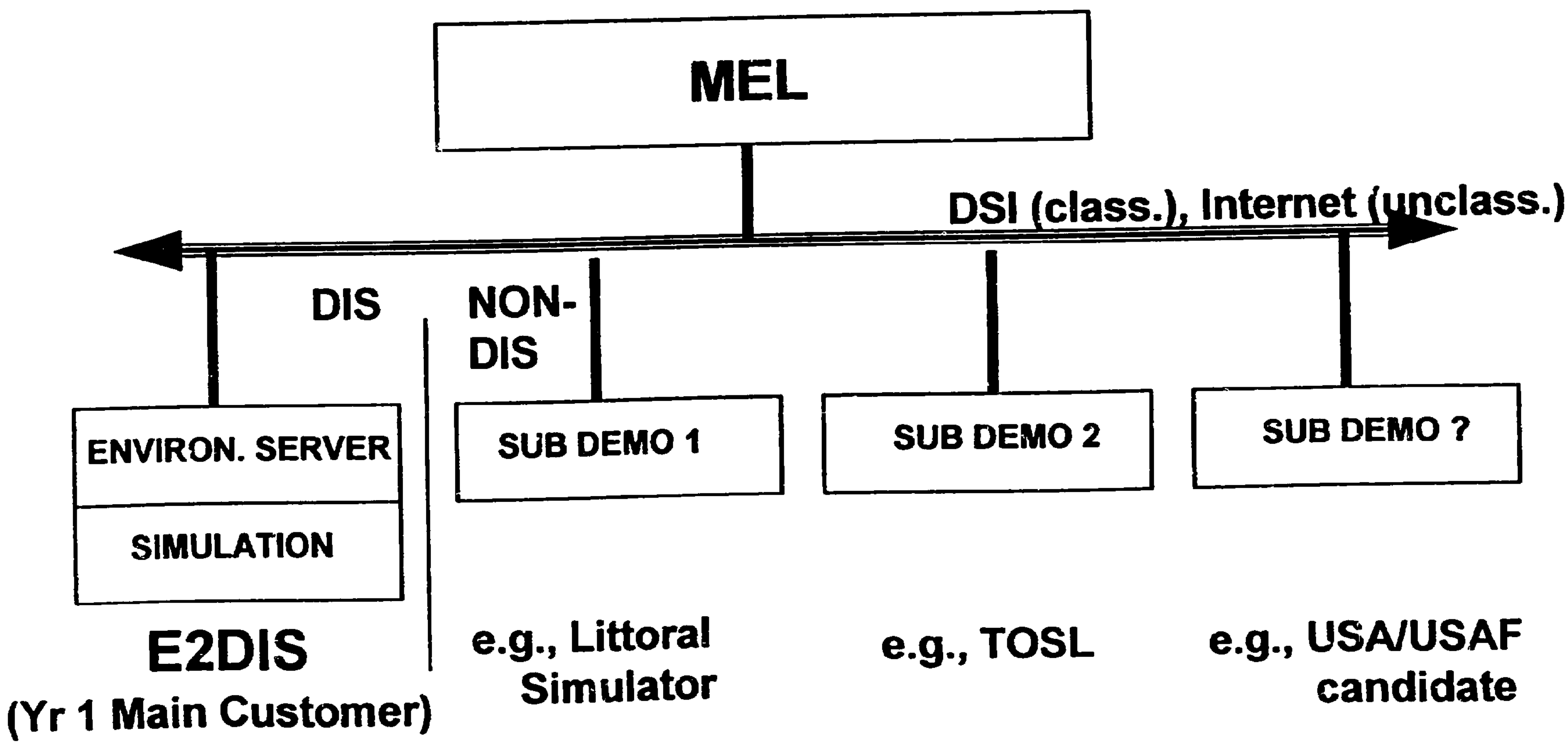
  SW US (YEAR 1)

  SE US (YEAR 2)

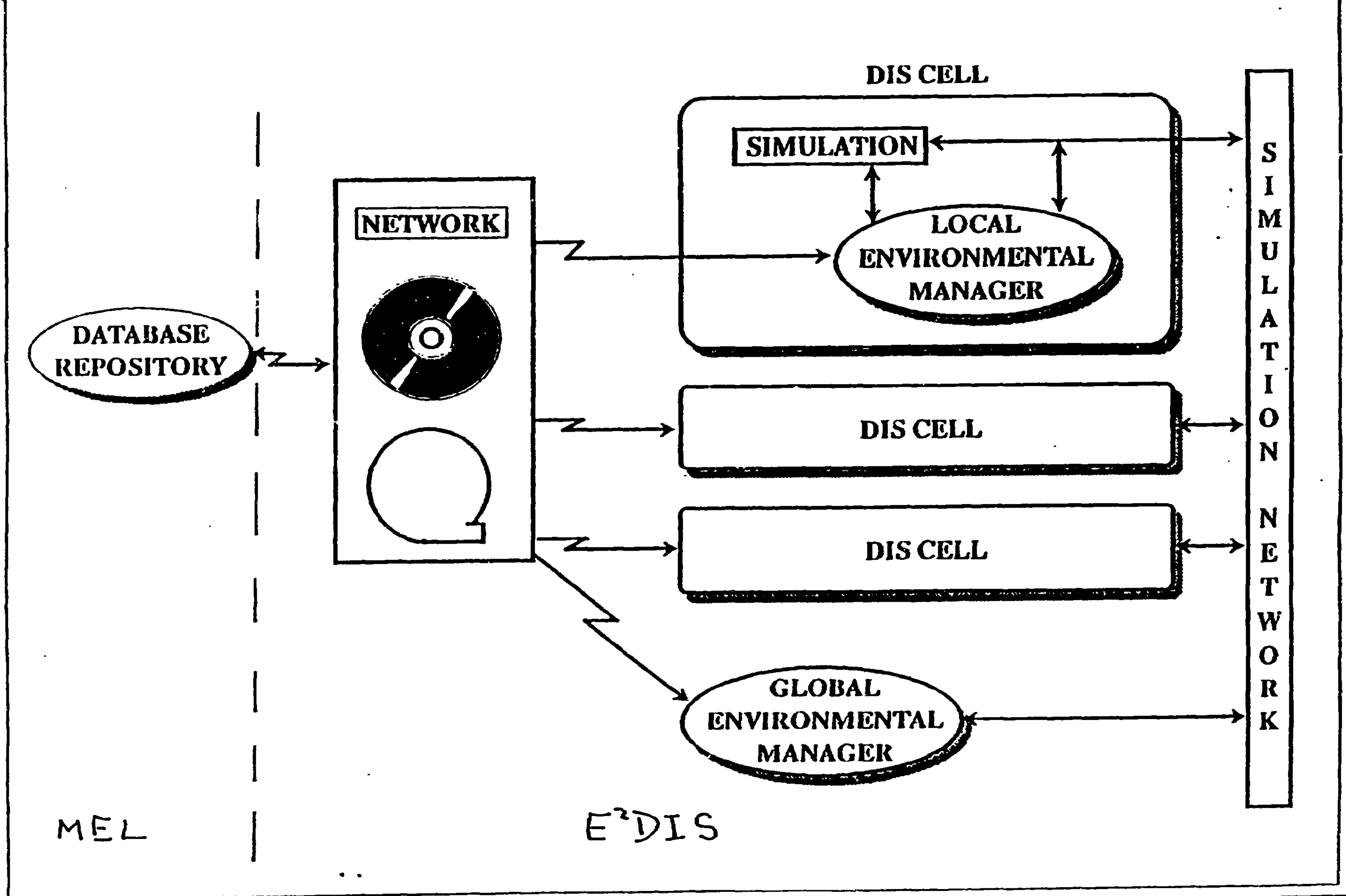
DMSO (MEL)

Common Data Bases, Real World Data

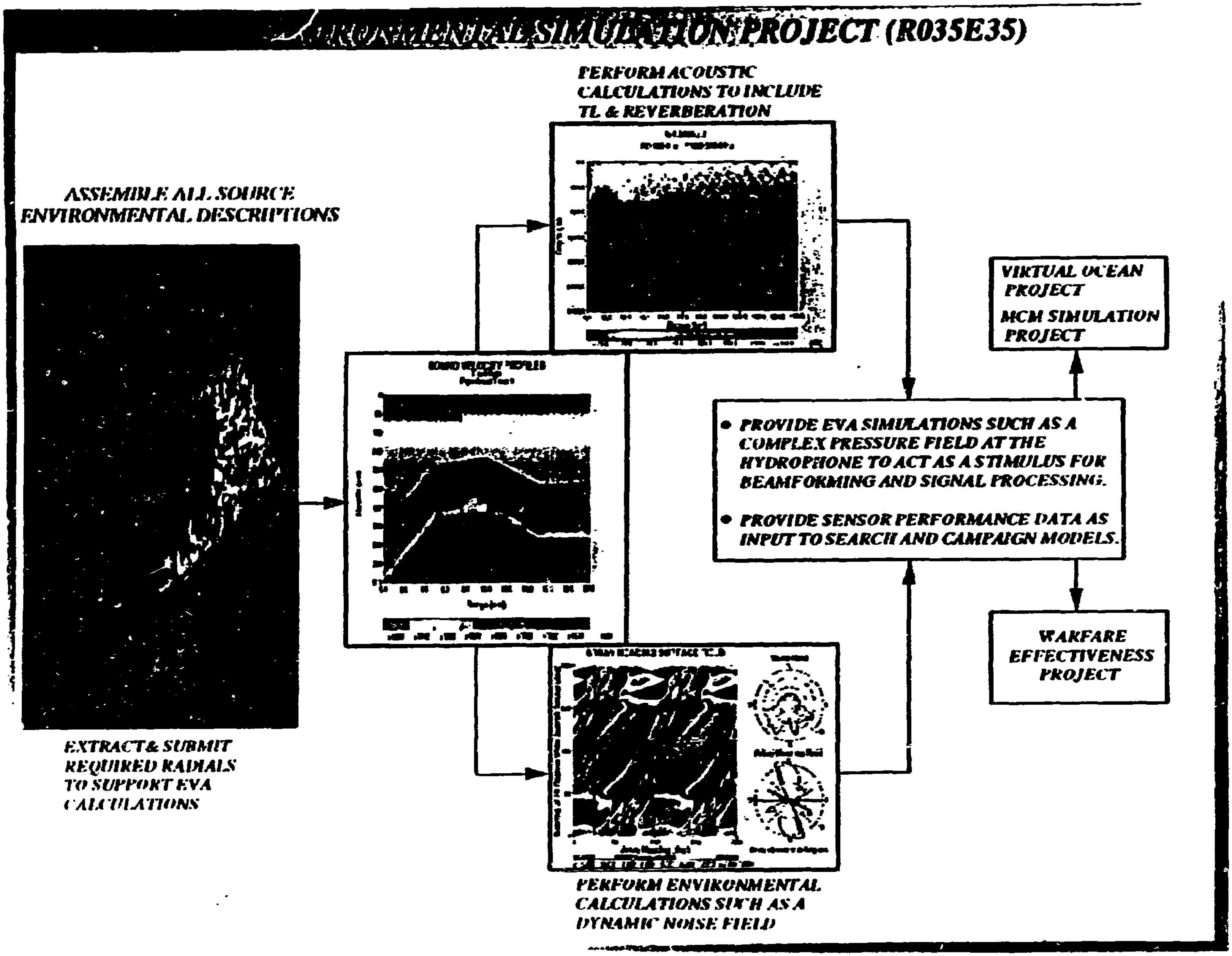
CANDIDATE YR 1 DEMO. STRATEGY

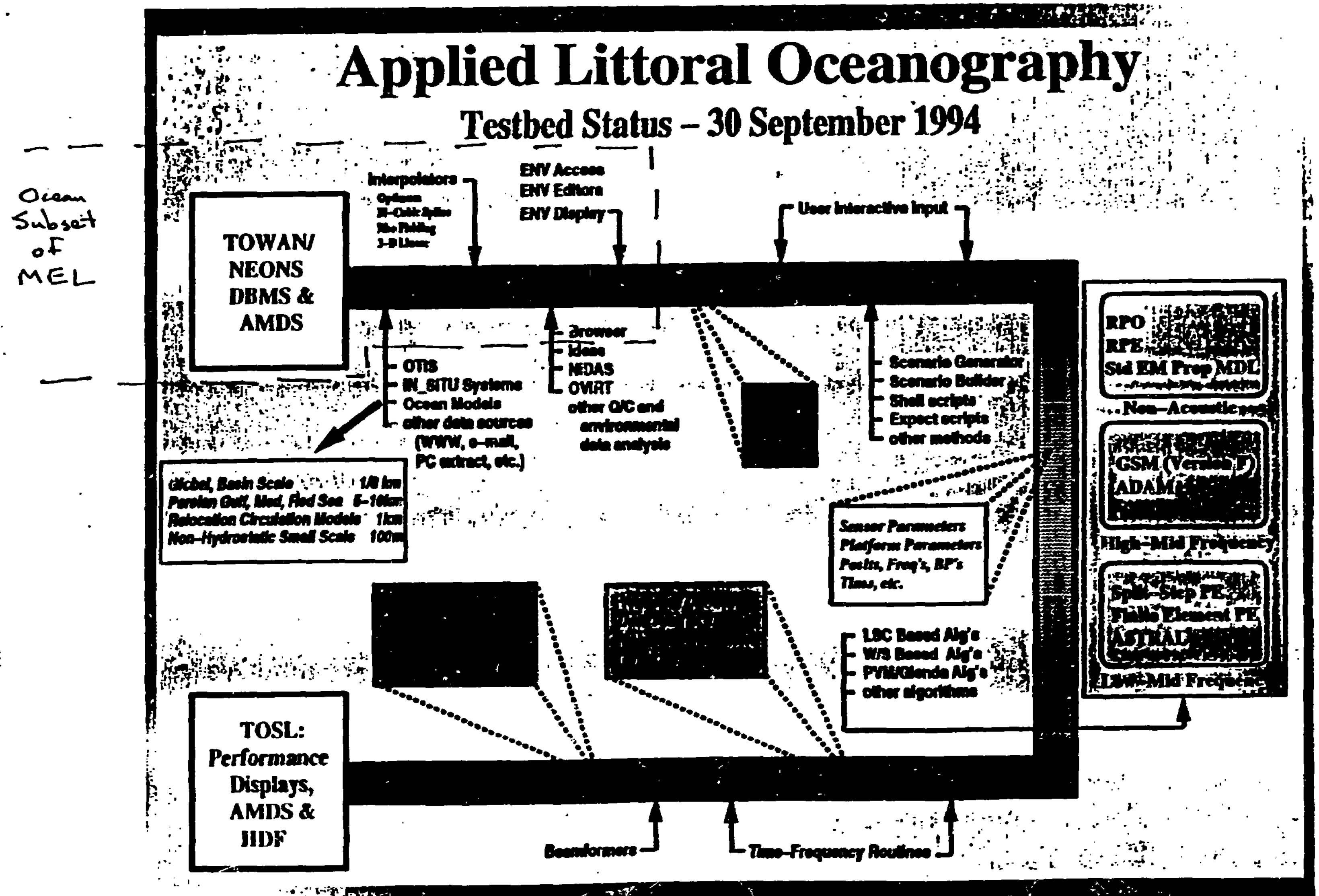


ENVIRONMENTAL MANAGER SYSTEM



RELATION TO E^2DIS


ENVIRONMENTAL SIMULATION PROJECT (R035E35)
ASSEMBLE ALL SOURCE ENVIRONMENTAL DESCRIPTIONS
EXTRACT & SUBMIT REQUIRED RADIALS TO SUPPORT EVA CALCULATIONS
PERFORM ACOUSTIC CALCULATIONS TO INCLUDE TL & REVERBERATION
PERFORM ENVIRONMENTAL CALCULATIONS SUCH AS A DYNAMIC NOISE FIELD
• PROVIDE EVA SIMULATIONS SUCH AS A COMPLEX PRESSURE FIELD AT THE HYDROPHONE TO ACT AS A STIMULUS FOR BEAMFORMING AND SIGNAL PROCESSING.
• PROVIDE SENSOR PERFORMANCE DATA AS INPUT TO SEARCH AND CAMPAIGN MODELS.
VIRTUAL OCEAN PROJECT
MCM SIMULATION PROJECT
WARFARE EFFECTIVENESS PROJECT


Applied Littoral Oceanography
Testbed Status – 30 September 1994
TOWAN/ NEONS DBMS & AMDS
Interpolators
ENV Access
ENV Editors
ENV Display
User Interactive Input
OTIS
IN_SITU Systems
Ocean Models
other data sources (WWW, e-mail, PC extract, etc.)
Browser
Ideas
NIDAS
OVIRT
other Q/C and environmental data analysis
Scenario Generator
Scenario Builder
Shell scripts
Expect scripts
other methods
Global, Basin Scale 1/8 km
Persian Gulf, Med, Red Sea 5–10km
Relocation Circulation Models 1km
Non-Hydrostatic Small Scale 100m
Sensor Parameters
Platform Parameters
Posits, Freq's, BP's
Time, etc.
RPO
RPE
Std EM Prop MDL
Non-Acoustic
GSM (Version 1)
ADAM
High-Mid Frequency
Split-Step PE
Finite Element PE
ASTRAL
Low-Mid Frequency
LSC Based Alg's
W/S Based Alg's
PVM/Glenda Alg's
other algorithms
TOSL: Performance Displays, AMDS & HDF
Beamformers
Time-Frequency Routines
Ocean Subset of MEL

DMSO

COMMON DATA BASES, REAL WORLD DATA

TASK 6: COMMON LIBRARY EVALUATION

- IDENTIFY AND ACCESS INDEPENDENT DATA SETS FOR EVALUATION
- EVALUATE DATA BASES/SCENARIOS FOR DEMON-STRATION AREAS
- EVALUATE PROTOTYPE ARCHITECTURE USED FOR DEMONSTRATION

DMSO

COMMON DATA BASES, REAL WORLD DATA

DIRECT PARTICIPANTS

USN: NRL
COMNAVOCEANCOM
NAVOCEANO
FNMOC

USA: WES/CERC
ARL/BED

USAF: PL/GP
USAFETAC

Department of Defense
DIRECTIVE

September 26, 1991
NUMBER 8320.1

ASD(C3I)

SUBJECT: DoD Data Administration

References: (a) DoD Directive 5000.11, "Data Elements and Data Codes Standardization Program," December 7, 1964 (hereby canceled)
(b) DoD 5025.1-M, "Department of Defense Directives System Procedures," December 1990, authorized by DoD Directive 5025.1, December 23, 1988
(c) DoD Instruction 5000.12, "Data Elements and Data Codes Standardization Procedures," April 27, 1965
(d) DoD Instruction 5000.18, "Implementation of Standard Data Elements and Related Features," March 17, 1969
(e) through (r), see enclosure 1

A. REISSUANCE AND PURPOSE

This Directive:

1. Reissues reference (a).

2. Establishes policies for DoD data administration.

3. Authorizes the establishment of and assigns responsibilities for DoD data administration to plan, manage, and regulate data within the Department of Defense.

4. Authorizes the publication of DoD 8320.1-M, "DoD Data Administration Procedures," in accordance with (IAW) reference (b) that will supersede references (c) and (d).

5. Authorizes the establishment of a DoD Information Resource Dictionary System (DoD IRDS).

B. APPLICABILITY AND SCOPE

This Directive:

1. Applies to the Office of the Secretary of Defense (OSD), the Military Departments (including the National Guard and Reserve components), the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Unified and Specified Combatant Commands, the Inspector General of the Department of Defense, the Defense Agencies, and the DoD Field Activities (hereafter referred to collectively as "the DoD Components").

2. Applies to all information systems (ISs) of the DoD Components, whether those systems share data with other systems or not. Hereafter, this

Directive shall use the general term "information system (IS)" to refer to all of the applicable systems and subsystems.

3. Applies to data in the ISs, including data elements, codes and values, and symbols.

4. Applies when levying information reporting requirements IAW DoD Directive 7750.5 (reference (e)).

5. Applies throughout the life cycle of the ISs with management and acquisition reviews implemented in DoD Directives 7920.1 and 5000.1, and DoD Instruction 5000.2, references (f) through (h).

6. Applies to the data elements and data values of systems governed by reference (g), including:

a. ISs associated with office automation; personnel, business, and administrative systems; financial accounting and contractual information systems; and inventory control associated with acquisition of programs and systems;

b. Metadata (i.e., data about data) that affects system interoperability or production and logistics support.

7. Applies to data elements and data values under the stewardship (i.e., management responsibility, but not data definition ownership) of the Under Secretary of Defense (Acquisition) including data elements and data values that are required to be unique to the operation of equipment and software that are an integral part of a planned acquisition and deployable weapon or weapons system and related test equipment.

8. Does not apply to data elements and data values that are required to be unique for use in cryptologic activities, but does apply to general signals intelligence reporting and the end-products of cryptologic programs and systems disseminated to noncryptologic activities. Those cryptologic activities shall assist in the development of any bridging techniques.

C. DEFINITIONS

Terms used in this Directive are defined in enclosure 2.

D. CONCEPT

1. DoD data administration must be implemented in ways that enhance mission performance through the effective, economic acquisition and use of data. Two objectives of DoD data administration are to:

a. Support DoD operations and decisionmaking with data that meets the need in terms of availability, accuracy, timeliness, and quality.

b. Structure the ISs in ways that encourage horizontal, as well as vertical, sharing of data in the Department of Defense, and with other

Government agencies, private sector organizations, and allied nations, consistent with national security and privacy requirements.

2. Data administration functions include procedures, guidelines, and methods for effective data planning, analysis, standards, modeling, configuration management, storage, retrieval, protection, validation, and documentation.

3. Effective data administration improve interoperability among the ISs and facilitates data exchange, provides the means for data sharing, controls redundancy, minimizes data handling, and improves data integrity by reducing the cost and time required to transform, translate, or research the meaning of differently named but otherwise identical data elements.

4. Data administration improves the way an organization uses data by defining data structuring rules and standards, planning for the efficient use of data, and coordinating data definitions and structures among organizational components.

5. The primary tools of data administration are an IRDS and a functional data structure and rules. That structure and the rules establish a framework within which to determine what data elements should be standardized, describe how data elements should be grouped, and state which data elements should be located in the DoD IRDS. The functional data structure is determined by the data needs of the organization. The DoD IRDS is used to define, structure, and maintain metadata for data administration.

6. The DoD IRDS provides a medium for defining metadata, cross-referencing, and consistency checking, and supports the standardization of data element names, definitions, and relationships. Metadata includes a wide variety of data element information such as data element access name, descriptive name, alternate names, data element definition, data type, data length, storage format, data validation rules, and the functional area or the IS that is the source of the data element.

7. Data elements are the fundamental unit of data used in the ISs. Standardization of data elements will result in efficiently storing data in databases and files, and in effectively accessing and using DoD standard data elements by multiple users.

E. POLICY

It is DoD policy to:

1. Implement data administration aggressively in ways that provide clear, concise, consistent, unambiguous, and easily accessible data DoD-wide, and that minimize the cost and time required to transform, translate, or research differently described, but otherwise identical, data.

2. Standardize and register data elements to meet the requirements for data sharing and interoperability among ISs throughout the Department of Defense.

3. Use applicable Federal, national, and international standards before creating DoD standards or using common commercial practices.

4. Promote standardization of data elements in the Department of Defense in a manner consistent with requirements for sharing data among the OSD Principal Staff Assistants, the Heads of the DoD Components; and with the other Federal Agencies and organizations and other nations under treaty or international agreements.

5. Levy the burden and cost of conversion to DoD standard data, regardless of the origin of the requirement for information, on the Head of the DoD Component responsible for the DoD IS using nonstandard data, unless otherwise mutually agreed by all parties involved, and the DoD Data Administrator (DoD DA) is informed of the agreement.

6. Coordinate applicable standards for information, information processing, and telecommunications IAW DoD data administration procedures.

F. RESPONSIBILITIES

1. The Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, as the designated senior DoD information management (IM) official, shall:

a. Prescribe DoD data administration policies, procedures, criteria, rules, and terms for use by the Heads of the DoD Components and monitor compliance by the Heads of the DoD Components.

b. Issue and maintain DoD data administration procedures in coordination with appropriate DoD officials.

c. Designate or assign a DoD DA. Responsibilities of the DoD DA are in enclosure 3.

d. Review and approve the DoD Data Administration Plan submitted by the DoD DA.

e. Be the final authority for determining the resolution of DoD data administration issues.

f. Represent the Department of Defense to other Government agencies, standards developing organizations, and industry on matters pertaining to the development and adoption of data standards or delegate such representation to the DoD DA or the appropriate functional data administrator (FDAd).

2. The OSD Principal Staff Assistants, within their areas of responsibility, shall:

a. Represent their interests to the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence and the DoD DA on all matters about data administration.

b. Designate a FDAd or exercise FDAd responsibilities for their functional categories of data listed in enclosure 4. Responsibilities for a FDAd are in encl[illegible] 3.

c. Plan and provide resources necessary to effectively carry out assigned functional data administration responsibilities.

d. Review, approve, and submit to the DoD DA their portion of the DoD Data Administration Plan.

3. The Heads of the DoD Components shall:

a. Designate a DoD Component DA (CDAd) who shall exercise CDAd responsibilities, consistent with section E., above, and DoD data administration procedures. Responsibilities for the CDAd are in enclosure 3.

b. Represent their interests to the OSD Principal Staff Assistants, the DoD DA, and the FDAd on all matters for data administration.

c. Plan and provide resources necessary to effectively execute CDAd responsibilities.

d. Manage data IAW section E., above, and DoD data administration procedures.

G. PROCEDURES

1. The DoD data administration procedures shall:

a. Implement the policy in section E., above.

b. Define and implement strategies and criteria for converting from nonstandard data elements to DoD standard data elements.

c. Develop requirements for methods and capabilities that permit rapid generation and manipulation of data models.

d. Apply to all data elements that are used in, but are not limited to, the functional areas listed in enclosure 4.

2. DoD data administration procedures shall provide uniform instructions for implementing DoD data administration. These procedures shall:

a. Identify planning, reporting, and resources requirements for effective DoD data administration.

b. Establish DoD standard data element naming conventions and uniform procedures to define and maintain all DoD standard data elements.

c. Describe the means to satisfy all data requirements for new or modified ISs through the use of standard data elements.

d. Describe the detailed administrative relationships among the DoD DA, the FDAds, the CDAds, and the users of data.

e. Provide guidance for IRDS users, including how to access and use the metadata.

f. Identify the mechanism to structure, store, collect, and maintain metadata within the Department of Defense so that metadata:

(1) Is readily accessible to and understood by the Heads of the DoD Components.

(2) Can be made available to commercial enterprises proposing or developing defense systems.

(3) Is protected IAW the FAR and DoD Directive 5200.1 (references (i) and (j)).

g. Determine the relationships and applicability of DoD data administration to references (e) through (h) and (k) through (o) that govern the ISs of the Heads of the DoD Components.

3. DoD standard data elements shall be used when stating information requirements and when designing, developing, or modifying the ISs. Compliance shall be determined by officials authorized to review and approve information systems IAW DoD Directives 7750.5, 7920.1, and 5000.1 (references (e) through (g)).

4. Nonstandard data acquired from commercial-off-the-shelf data sources or other sources external to the Department of Defense shall be converted to DoD standard data elements only when justified by mission requirements, feasibility analysis, and a cost-benefits analysis.

H. EFFECTIVE DATE

This Directive is effective immediately.

Donald J. Atwood

Donald J. Atwood
Deputy Secretary of Defense

Enclosures - 4
1. References
2. Definitions
3. DoD Data Administrators' Responsibilities
4. OSD Principal Staff Assistant Functional Areas of Responsibility

(e) DoD Directive 7750.5, "Management and Control of Information Requirements," August 7, 1986

(f) DoD Directive 7920.1, "Life-Cycle Management of Automated Information Systems (AISs)," June 20, 1988

(g) DoD Directive 5000.1, "Defense Acquisition," February 23, 1991

(h) DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991

(i) "Federal Acquisition Regulation," current edition

(j) DoD Directive 5200.1, "DoD Information Security Program," June 7, 1982

(k) DoD Directive 5105.19, "Defense Information Systems Agency (DISA)," June 25, 1991

(l) DoD Directive 4630.5, "Compatibility and Interoperability of Tactical Command, Control, Communications, and Intelligence Systems," October 9, 1985

(m) DoD Directive 2010.6, "Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization," March 5, 1980

(n) DoD Instruction 7750.7, "DoD Forms Management Program," May 31,1990

(o) DoD 4120.3-M, "Defense Standardization and Specification Program Policies, Procedures and Instructions," August 1978, authorized by DoD Directive 4120.3, February 10, 1979

(p) Joint Pub 1-02, "Department of Defense Dictionary of Military and Associated Terms," December 1, 1989

(q) NBS Special Publication 500-152, "Guide to Information Resource Dictionary System Applications: "General Concepts and Strategic Systems Planning," April 1988

(r) "American National Standard Dictionary for Information Systems (ANSDIS)," ANSI/X3.172-1990, American National Standards Institute

DEFINITIONS

1. Automated Information System (AIS). A combination of information, computer, and telecommunications resources and other information technology that collects, records, processes, stores, communicates, retrieves, and displays data.

2. Data. Representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means. Any representations such as characters or analog quantities to which meaning is, or might be, assigned (Joint Pub 1-02 (reference (p))).

3. Data Administration. The responsibility for definition, organization, supervision, and protection of data within an enterprise or organization (NBS Special Publication 500-152 (reference (q))).

4. Data Administrator (DA). A person or group that ensures the utility of data used within an organization by defining data policies and standards, planning for the efficient use of data, coordinating data structures among organizational components, performing logical data base designs, and defining data security procedures (reference (q)).

5. Database. A collection of interrelated data, often with controlled redundancy, organized according to a schema to serve one or more applications; the data are stored so that they can be used by different programs without concern for the data structure or organization (ANSDIS, ANSI/X3.172-1990 (reference (r))).

6. Database Administrator. A person or group that enforces policy on "how," "where," and "in what manner" data is stored and maintained in each database. Provides information to the DA on organizational use of data within the subject database.

7. Data Dictionary. A specialized type of database containing metadata that is managed by a data dictionary system; a repository of information describing the characteristics of data used to design, monitor, document, protect, and control data in ISs and databases; an application of a data dictionary system (reference (q)).

8. Data Element. A basic unit of information having a meaning and subcategories (data items) of distinct units and values (reference (p)).

9. Data Item. A subunit of descriptive information or value classified under a data element (reference (p)).

10. Data Model. Identifies the data, their attributes, and relationships or associations with other data.

11. Data Value. A value associated with a data element. One of the allowable values of a data element. Synonym of "a data item."

12. Functional Area. A range of subject matter grouped under a single heading because of its similarity in use or genesis.

13. Imagery. Collectively, the representations of objects reproduced electronically or by optical means on film, electronic display devices, or other media (reference (p)).

14. Information. The meaning that a human assigns to data by means of the known conventions used in their representation (reference (p)).

15. Information Resource Dictionary System (IRDS). A set of standard specifications for a data dictionary system resulting from U.S. Federal and national standards efforts; a computer software system conforming to those standards that provides facilities for recording, storing, and processing descriptions of an organization's significant information and information processing resources (NBS Special Publication 500-152 (reference (q))).

16. Information System (IS). A combination of information, information technology, and personnel resources that collects, records, processes, stores, communicates, retrieves, and displays either manually or with varying degrees of automation.

17. Metadata. Information describing the characteristics of data; data or information about data; and descriptive information about an organization's data, data activities, systems, and holdings (reference (q)).

18. Nonautomated. Manual, without benefit or hindrance of machines.

19. OSD Principal Staff Assistants. The Under Secretaries of Defense, the Assistant Secretaries of Defense, the General Counsel of the Department of Defense, the Inspector General of the Department of Defense, the Comptroller of the Department of Defense, the Assistants to the Secretary of Defense, the OSD Directors who report directly to the Secretary or Deputy Secretary of Defense, and the DoD Coordinator for Drug Enforcement Policy and Support.

20. Signals Intelligence (SIGINT). A category of intelligence information, either individually or in combination, comprising all communications intelligence, electronic intelligence, foreign instrumentation signals intelligence, and telemetry intelligence (reference (p)).

21. Standard. An exact value, a physical entity, or an abstract concept established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results. A fixed quantity or quality (reference (p)).

22. Standard Data Element. Data element registered IAW DoD data administration procedures.

23. Symbology. Any graphic representation of concepts or physical objects.

DOD DATA ADMINISTRATORS' RESPONSIBILITIES

A. The DoD Data Administrator shall:

1. Implement and manage the DoD data administration policies and procedures IAW section E., above, of this Directive and DoD data administration procedures.

2. Interpret DoD data administration policies, procedures, and standards, and coordinate FDAd and CDAd procedures with the DoD data administration procedures.

3. Register metadata from functional areas assigned as DoD standard data.

4. Develop, operate, and maintain a DoD IRDS that is easily accessible to all the Heads of the DoD Components and users, and supports the DoD data administration procedures.

5. Review and approve or disapprove proposed changes to DoD standard data elements, when existing standard data elements do not satisfy new requirements.

6. Annually review and submit the consolidated and updated DoD Data Administration Plan to the DoD Senior IM official IAW DoD data administration procedures, and DoD 4120.3-M (reference (o)).

7. Plan and provide resources necessary to effectively carry out DoD data administration responsibilities, giving consideration not to abridge the authority and responsibility of the OSD Principal Staff Assistants.

B. A Functional Data Administrator shall:

1. Implement data administration procedures, IAW section D., above, of this Directive and DoD data administration procedures, for the functional area assigned.

2. Approve metadata in the respective functional areas of responsibility listed in enclosure 4, and for proposed DoD standard data elements, only when an existing standard does not support the new requirement.

3. Annually review, update, and prepare the portion of the DoD Data Administration Plan that addresses the functional area assigned, and submit to the DoD DA, through the OSD Principal Staff Assistants.

4. Recommend functional data elements for standardization.

C. A Component Data Administrator shall:

1. Manage the DoD Component Data Administration IAW section E., above, of this Directive and the DoD data administration procedures.

2. Review proposed changes to DoD standard data elements and forward changes to the DoD DA and the appropriate FDAd for approval.

3. Identify the interface between the users, database administrators, and application developers of the ISs within the DoD Component and act as the liaison to the DoD DA and the FDAds.

4. Represent CDAd interests to the OSD Principal Staff Assistants, the DoD DA, and the FDAds.

5. Annually review, update, and submit to the DoD DA the portion of the DoD Data Administration Plan that addresses DoD Component data administration.

OSD PRINCIPAL STAFF ASSISTANT
FUNCTIONAL AREAS OF RESPONSIBILITY

This listing is descriptive, not mandatory. See appropriate charter directives.

A. The Under Secretary of Defense (Acquisition)

- Acquisition
- Research and engineering
- Science and technology
- Modeling and Simulation
- Nuclear, atomic energy
- Basic, applied research
- Development, test, and evaluation
- Weapon System Interoperability
- Weapon and Weapon System Support Engineering, Design and Test

B. The Assistant Secretary of Defense (Production and Logistics)

- Logistics
- Transportation
- Procurement, contracts
- Construction
- Real property acquisition, repair, use, and disposal
- Configuration management
- Reliability, maintainability
- Manufacturing, materiel
- Base operations
- Standardization

C. The Under Secretary of Defense for Policy

- National security
- Strategic resources
- Environment preservation
- International security
- Trade security
- Civil defense
- Crisis management

D. The Assistant Secretary of Defense for Command, Control, Communications, and Intelligence

- Intelligence, imagery
- Telecommunications
- C3I systems
- Investigative security
- Information resources management
- Mapping, charting, and geodesy
- Audio, visual
- Defense security
- Information management
- Sea/air/ground operations, fire support
- Country and political jurisdiction codes

E. The Comptroller of the Department of Defense

- Budget
- Fiscal
- Finance
- Accounting

F. The Assistant Secretary of Defense (Force Management and Personnel)

- Civilian personnel
- Military personnel, manpower
- Military dependents
- Unit administration
- Mobilization
- Compensation
- Training and education
- Equal employment opportunity

G. The Assistant Secretary of Defense (Health Affairs)

- Health, medical programs
- Health, medical care
- Military dependent health affairs

H. The Assistant Secretary of Defense (Legislative Affairs)

- House affairs
- Senate affairs
- Legislation
- Liaison

I. The Assistant Secretary of Defense (Public Affairs)

- Public communication
- Community relations
- Dissemination of information
- Freedom of information
- Defense news, public information activities

J. The Assistant Secretary of Defense (Program Analysis and Evaluation)

- Defense program analysis
- Defense program evaluation
- Economic, resource planning
- Theater assessment, planning

K. The Assistant Secretary of Defense (Reserve Affairs)

- Reserve personnel
- Reserve military dependents
- Military technicians
- Reserve compensation

L. The Assistant Secretary of Defense (Special Operations/Low Intensity Conflicts)

- Special operations/low intensity conflicts (SO/LIC) mission assessment
- SO/LIC requirements, planning
- Terrorism

M. <u>The Inspector General of the Department of Defense</u>

- Audit
- Criminal investigations
- Inspections

N. <u>The General Counsel of the Department of Defense</u>

- Legal, regulation
- Standards of conduct

O. <u>The Director of Administration and Management, Office of the Secretary of Defense</u>

- Privacy Act
- Organization, management planning
- DoD history

30 M

BATTLE FORCE TACTICAL TRAINING (BFTT)

James Hammond

CNO MESSAGE 051905Z DEC 91

" . . . THE CONCEPT THAT THE <u>SHIP</u> WHEN PROPERLY SUPPORTED PRESENTS THE <u>MOST EFFECTIVE TRAINING SITE</u> FOR APPROPRIATE OPERATIONAL AND FUNCTIONAL TRAINING. THIS ALLOWS SHIPS <u>TO TRAIN USING OWN EQUIPMENT</u>, SYSTEM CONFIGURATIONS AND OPERATIONAL/CASUALTY PROCEDURES. ENHANCED TRAINING EFFICIENCY WILL RESULT AS TRAINING REDUNDANCY IS IDENTIFIED/ELIMINATED, A NECESSARY REALITY IN TERMS OF FUTURE <u>DOWN-SIZING</u> OF THE NAVY."

BATTLE FORCE TACTICAL TRAINING (BFTT)

BFTT FOCUS

- INCREMENTAL DEVELOPMENT BY BASELINES
- LEVERAGE OFF OF EXISTING TRAINING SYSTEMS
- UTILIZE NAVY STANDARD DATABASES
- COORDINATE AND INTEGRATE WITH OTHER PROGRAMS
- BUILD ONLY WHAT IS NECESSARY
- USE EXISTING CONTRACTS WHEN POSSIBLE
- ACCELERATE TO SUPPORT ATO/TTS AND DOWNSIZING

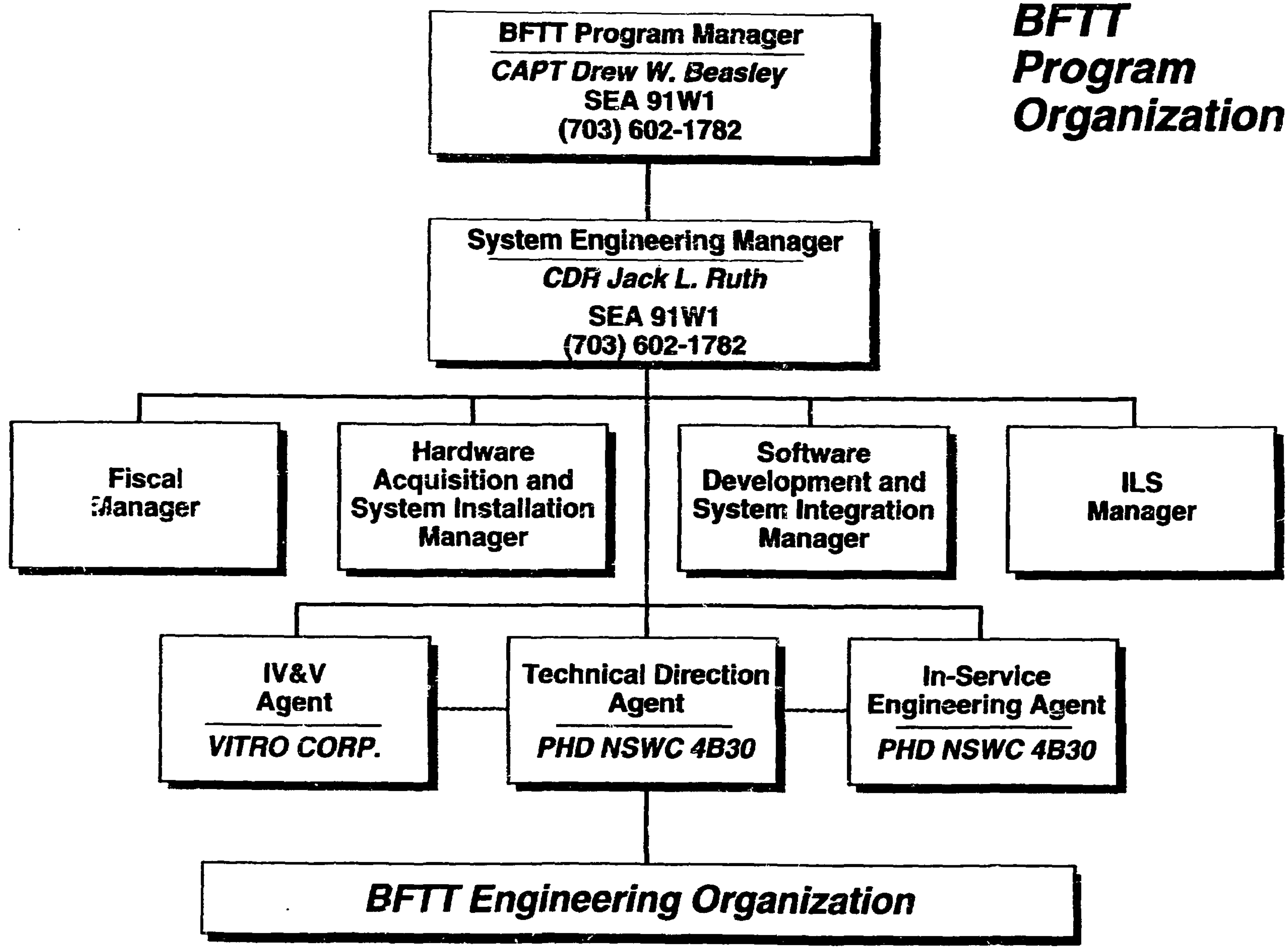
BATTLE FORCE TACTICAL TRAINING (BFTT)

PROGRAM SUPPORTS

- OPERATOR/UNIT/TEAM TRAINING
- AFLOAT TRAINING ORGANIZATION (ATO)/ TACTICAL TRAINING STRATEGY (TTS)
- BG/BF COMMANDER TRAINING
- JOINT TRAINING

BFTT System Update

BFTT Program Organization



7 July 1994

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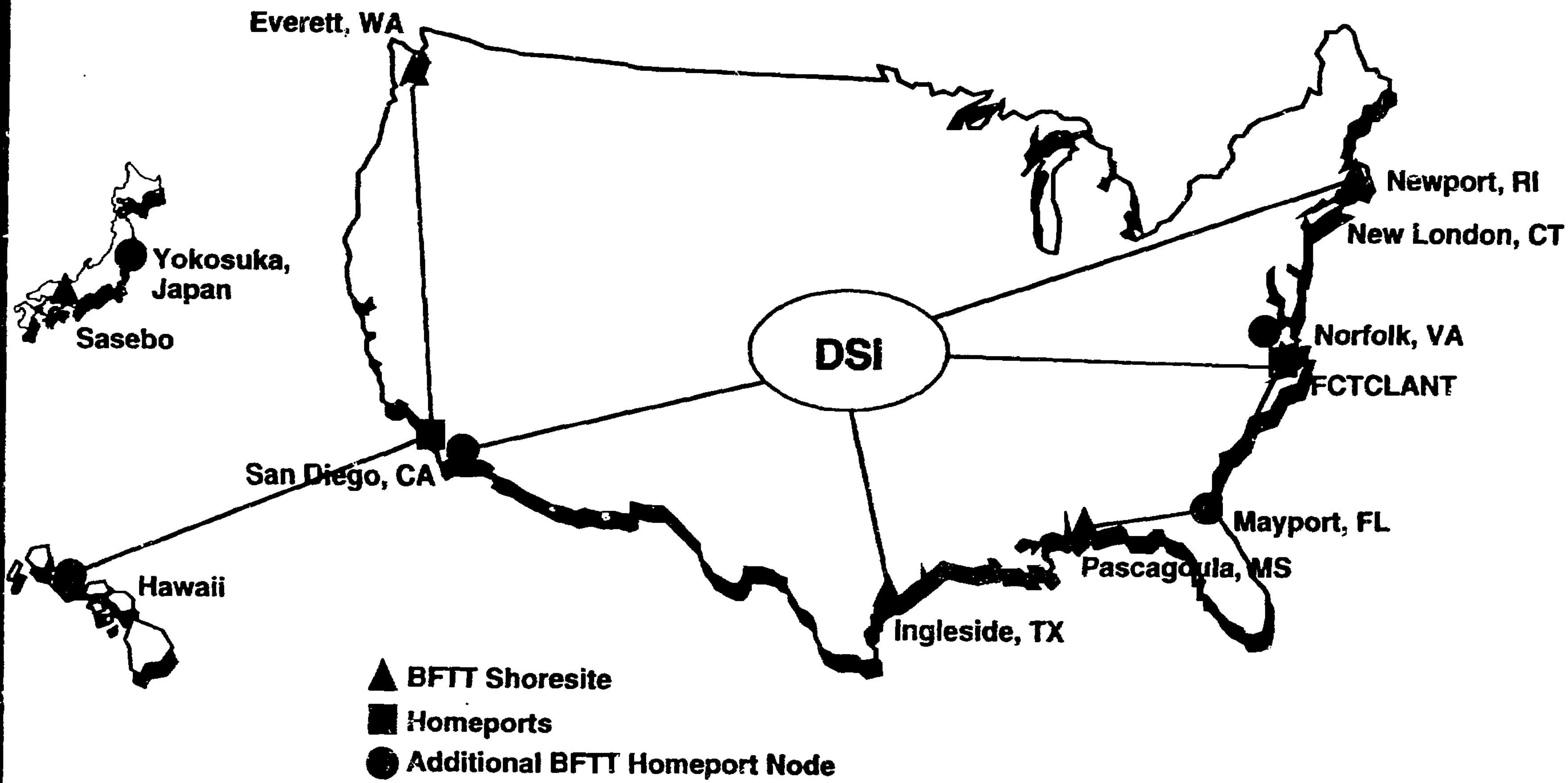
BFTT System Update

BFTT Overview: Team Training Model



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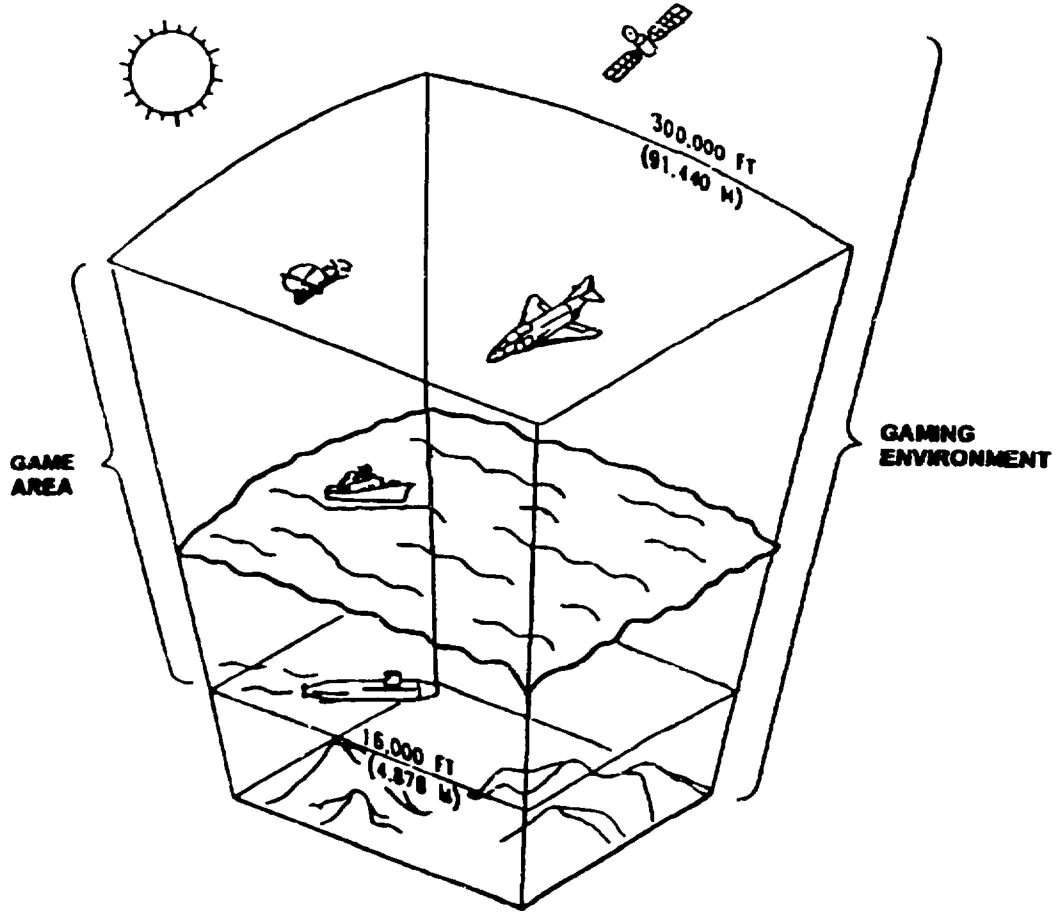
BFTT System Users

- Shipboard Combat System Training Team
  - Train operator through unit combat system team
  - Evaluate operator through unit performance
- Afloat Training Group (ATG)
  - Train unit Combat System Training Team (CSTT)
  - Evaluate operator, team, and unit performance
- Fleet and Joint Commanders
  - "Fleet" refers to numbered FLEET, COMTRAs, and TACTRAGRUs
  - Train BG/BF team
  - Evaluate BG/BF performance
- Other Domain Applications
  - Mission rehearsal
  - System readiness evaluation
  - Test and evaluation, research and development
  - Doctrine development and evaluation

BATTLE FORCE TACTICAL TRAINING (BFTT)

GAMEBOARD



- 4000 X 4000 MILES
- ALTITUDE 300K FT; OCEAN DEPTH 16K FT
- LOCATION: WORLD WIDE
- 2600 DIS ENTITIES
  - PLATFORMS/
    GUIDED WEAPONS 2,000
  - COUNTERMEASURES 500
  - ENVIRONMENTS 100

BFTT SHIP CLASSES AND SHORE NODES

SHIP CLASSES

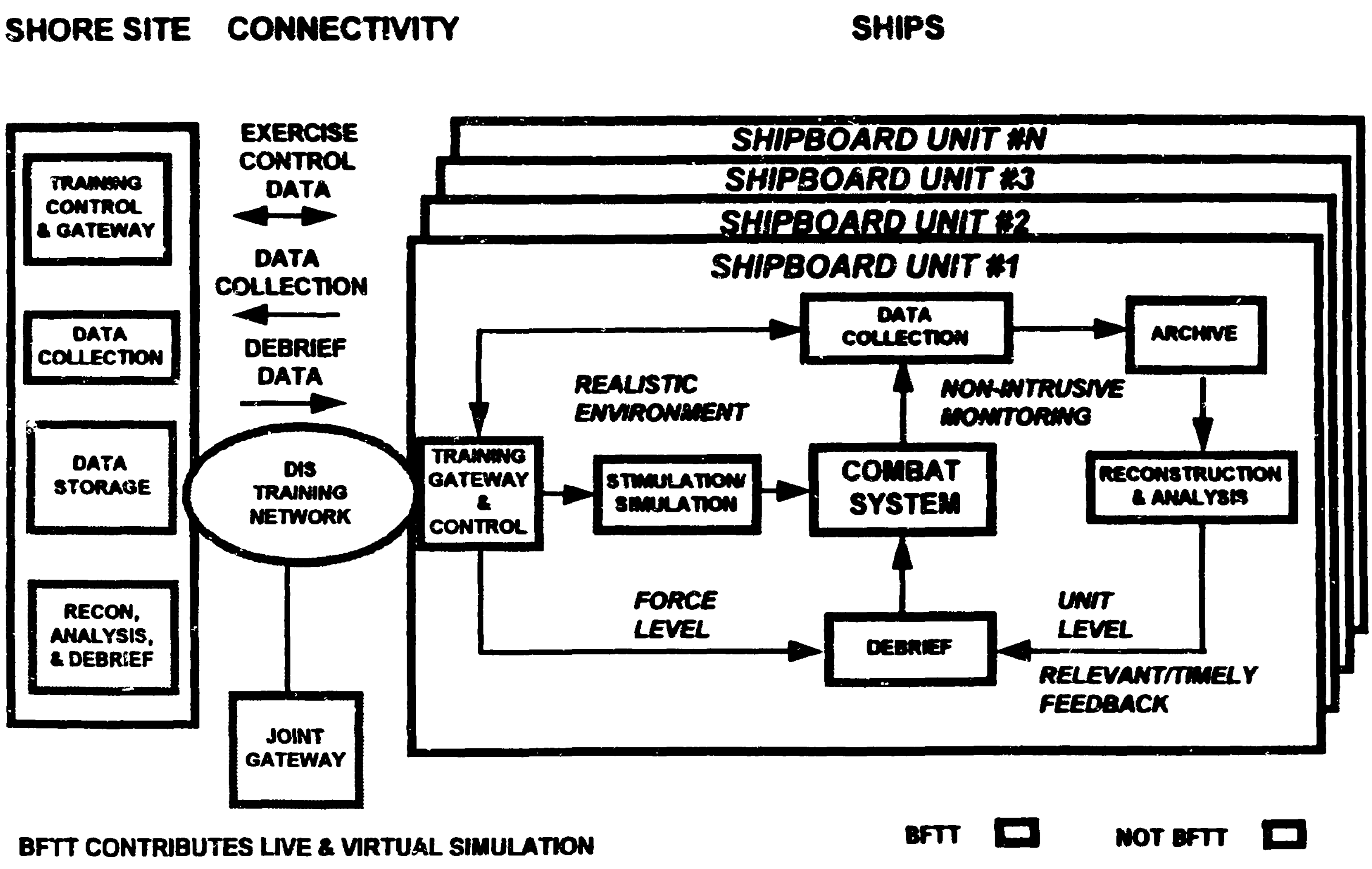
CG 47
DDG 51
DDG993
CGN 36
CV/CVN
DD 963
CGN 40*
FFG 7 (MOD 6)**
LHD 1
LHA 1
CVN 76 ***
LPD 17 ***
LCC 19
LSD 41/49
LPH 12
AOE 1/6
MCM 1
MHC 51

SHORE NODES

EVERETT, WA
YOKOSUKA, JAPAN
SASEBO, JAPAN
PEARL HARBOR, HI
SAN DIEGO, CA (FCTCPAC)
INGLESIDE, TX
PASCAGOULA, MS
MAYPORT, FL
NORFOLK, VA (FCTCLANT)
NEW LONDON, CT
NEWPORT, RI

* EDM ONLY
** PLANNING SUSPENDED UNTIL RESOLUTION OF CLASS LONGEVITY
*** SCN FUNDING PENDING

BFTT OVERVIEW: TEAM TRAINING MODEL



BFTT CONTRIBUTES LIVE & VIRTUAL SIMULATION

Development Test — IIA (DT-IIA)

- **DT-IIA Demonstration: 18 – 28 October 1994**
- **Multi-Ship / Shore Connectivity**
  - **USS HUE CITY (CG 66)**
  - **USS MISSISSIPPI (CGN 40)**
  - **FCTCLANT**
  - **NSWC DD**
- **Battleforce and Unit-Level Training**
- **Multi-Warfare: AAW, ASW, and EW**
- **DIS 2.0.3**
- **Technical Performance Measurement**
  - **Entities equal to or greater than 100**
  - **Latency < 300 MS**
  - **Synchrony > 98%**
  - **Debrief: 15 min (ship level), 90 min (force level)**

Development Test — IIB (DT-IIB)

- Scheduled: July – September 1995
- Must Demonstrate
  - Multi-ship / shore connectivity
    - DD 963, LSD 44, and CV/CVN
      Shoresite: FCTCPAC / San Diego, CA
  - Battleforce and unit-level training
  - Multi-warfare: AAW, ASW, ASUW, SEW, and STW
  - Link 4a, Link 11, and Link 16 simulations
  - JMCIS interface
  - DIS V2.0.3 +
- Technical Performance Measurements
  - Entities equal to or greater than 512
  - Latency < 300 MS
  - Synchrony > 99.9%
  - Debrief: 15 min (ship level), 90 min (force level)

Other Upcoming Events

- Committed to future I/ITSECs and STOW-Ex's
- DT-IIIA (FY96)
  - LANTFLT LHD, MCM, DDG 993, and Shore Site
- DT-IIIB (FY97)
  - LANTFLT and PACFLT
  - DDG 51, CGN 40, and LHA 5

M&S/ADS Technology Implementation

- BFTT distributed architecture backbone is DIS
  - DIS used throughout BFTT system
    - Joint communications
    - Ship/shore communications
    - Distribution of stow to shipboard OBTs
    - Inter-CSCI communications
  - DIS "wrapper" built for some reused CSCIs
  - Contribution to DIS enumeration
  - Contribution to feedback PDUs
- Use of models and databases to implement DIS

Use of Models and Databases to Implement DIS

- BFTT is customer of validated models and standard databases
  - Threats, friendlies, and neutrals
    - Order of battle, kinematics, and behavior
  - Mapping, charting, and geodesy
    - Display for exercise planning, conduct, and debrief
    - Radar navigation training
    - Airways
  - Environment
    - Acoustic and electromagnetic propagation
- Establish database working group
  - Coordinates with DMSO and other DoD database users to define standard database architecture, models, and DIS enumeration

BFTT Database Issues

BFTT Covers the Waterfront

- **Interfaces with most shipboard embedded trainers** JTCTS
- **Interfaces with many shore sites**
- **Must fill legacy databases under control of others**
- **Must be interoperable across DoD**
- **Must have flexible database architecture**
  - **Allow future growth**
  - **Support legacy databases**

BR-94-31-02

Applied Research Laboratories
THE UNIVERSITY OF TEXAS AT AUSTIN

BFTT Database Issues

- Distributed Interactive Simulator Architectures
  - Achieves fidelity by employing real data
  - Minimizes network traffic by pre-positioning correlated databases
- Formal Information Modeling Approach (DoD CIM)
  - FIPS 183 and 184 approach to information modeling as dictated by DoD (IDEFO and IDEFIX)
  - Same approach used by NWTDB, Army CATT series of trainers
- Choosing Optimum Database Schema
  - Balance between Object-Oriented Paradigm (future trend) and legacy RDBMS (DoD-installed base)
  - Use of Kepner-Tregoe decision analysis tools

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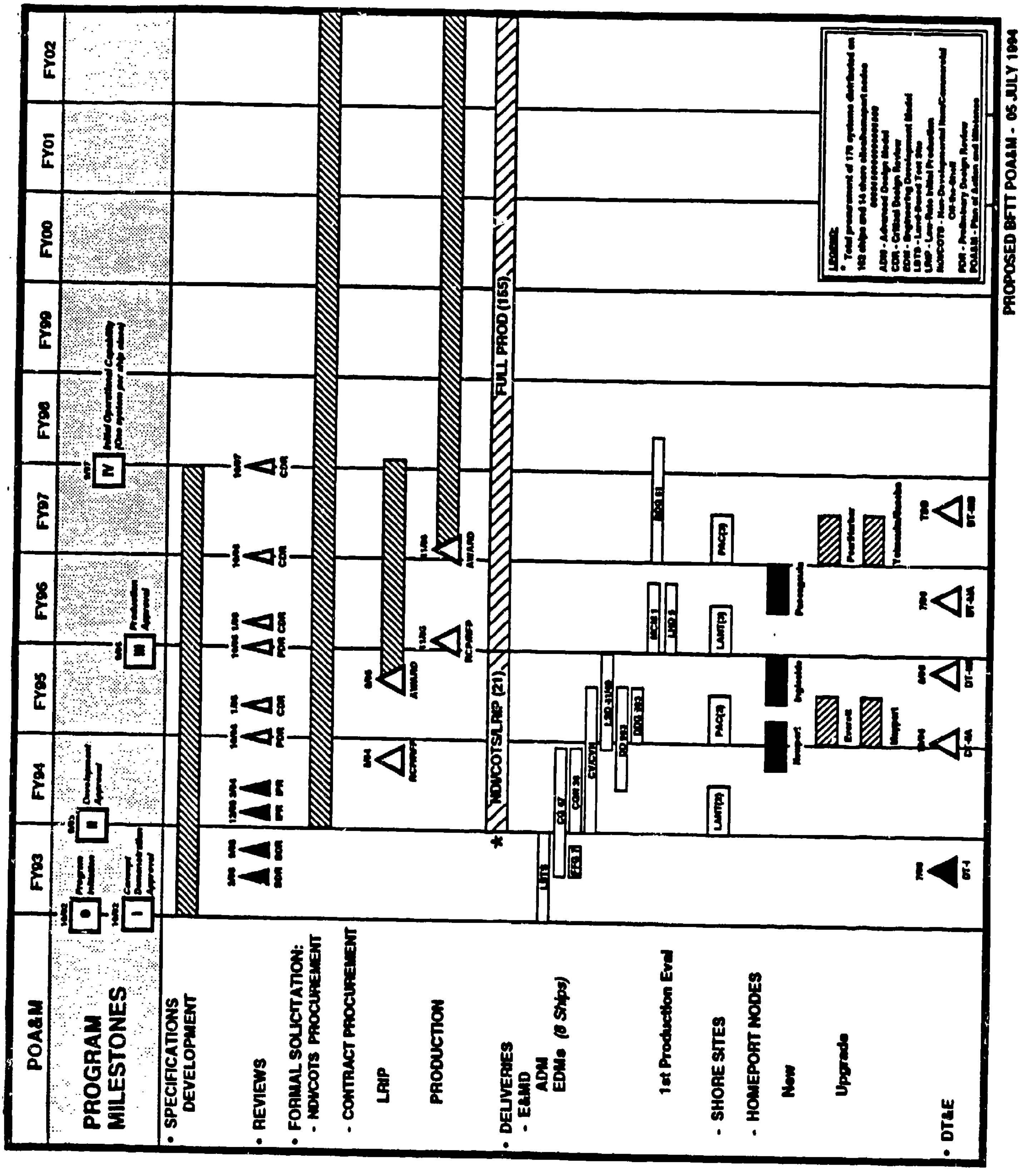
POA&M
PROGRAM MILESTONES
FY93
FY94
FY95
FY96
FY97
FY98
FY99
FY00
FY01
FY02
• SPECIFICATIONS DEVELOPMENT
• REVIEWS
• FORMAL SOLICITATION:
- NDI/COTS PROCUREMENT
- CONTRACT PROCUREMENT
LRIP
PRODUCTION
• DELIVERIES
- E&MD
ADM
EDMs (8 Ships)
1st Production Eval
- SHORE SITES
- HOMEPORT NODES
New
Upgrade
• DT&E
NDI/COTS/LRIP (21)
FULL PROD (155)
AWARD
PDR
CDR
PAC(3)
LANT(3)
PROPOSED BFTT POA&M - 05 JULY 1994

APPENDIX B: COMPLEX DATA TASK FORCE MEETING BRIEFING CHARTS

Organization of Complex Data Task Force

Complex Data Task Force

- **Complex Data Pilot Studies**
  - — Coordinated by Chien Huo
- **Categorization and Guidelines**
  - — Len Seligman (co-chair)
  - — Peter Valentine (co-chair)
- **Taxonomies**
  - — Iris Kameny (co-chair
  - — Dan Hogg (co-chair)

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RAND

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Eighth Modeling and Simulation I/DB Task Group Meeting

Complex Data Task Force Meeting

Iris Kameny —July 13, 1994

COMPLEX DATA ACTIVITIES

May 1993:	Meeting at AMSMO
August 1993:	Pilot study TRAC weapon performance data model
October 1993:	First meeting of Complex Data Task Force
November 1993:	MORS Working Group on Complex Data
February 1994:	Second meeting of Complex Data Task Force
April 6-7, 1994:	Categorization Meeting at IDA

DOCUMENTS

The RAND Metadata Management System (RMMS): A Metadata Storage Facility to Support Data Interoperability, Reuse, and Sharing, S. Cammarata, I. Kameny, J. Lender, and C. Replogle, RAND MR-163-OSD/A/AF, 1993.

Data Standardization and Data Reuse Guidance for Complex Data Elements, (Draft), DoD, 1994.

Complex Data Modeling Workshop for Modeling and Simulation (M&S), (Draft), Center for Standards, M&S Working Paper 1-2, 14 September, 1993

Goals of the Complex Data Task Force

Long Term

- M&S guideline to data modeling and standardization of complex data types
- Coordination with CIM to apply guideline to DoD level

Near Term

- Definition and categorization of complex data
- Data models and standards resulting from pilot studies from participating projects
- Coordination with CIM as to:
  - Issues and problems
  - Suggested extensions to data modeling (IDEF1X) and 8320.1-M-1 data standards

October 1993: Complex Data Meeting

Issues and needs:

- Definition of complex data and the categories of complex data to include multi-valued attributes/repeating groups, and derived data.
- Audit trails and tagging instance data (later assigned to Data VV&C Task Force)
- Interoperability and data exchange (issues more general than complex data)
- M&S Repository issues (assigned to Data Standards Task Force)
- Pilot studies: Possible candidates are CCTT and UTSS

November 1993: Complex Data Working Group at MORS SIMDAT Mini-Symposium

- Definition: complex data is data which contains inherent embedded information
- Examples: non-first normal form, aggregation/disaggregation, multi-dimensional, networks, continously variable systems, concepts and ideas
- Needs
  - Rapid prototyping with feedback
  - Enforce software engineering discipline
  - Better coordination: joint/combined, functional area
  - Better tools
  - Work with intelligence community

February 1994: Complex Data Task Force Meeting

- Definition: Complex data is that data which is not easily represented using existing data modeling technologies (e.g., IDEF1X), E-R modeling)
- Presentations from: Pete Valentine (JDBE) on complex data types, Miro Medek (MITRE) on interoperability and data exchange, Jeff Wolfe (CIM) on Defense Interoperability and data exchange, Jeff Wolfe (CIM) on Defense Information Repository System (DIRS), Duan Hufford on "DoD Data Standardization and Data Reuse Guidance for Complex Data Elements (draft)," Jack Teller on DMA data modeling project for MC&G standardization
- Formed subgroups: categorization, taxonomies, pilot studies

Complex Data Categorization Subgroup Meeting, April 6—7, 1994

Definition of complex data:

- Complex data is that data which is difficult or awkward to model using commonly used techniques (i.e., IDEF1X and other kinds of Entity-Relationship modeling

  (From the April 6—7, 1994 meeting of the Complex Data Categorization Subgroup)

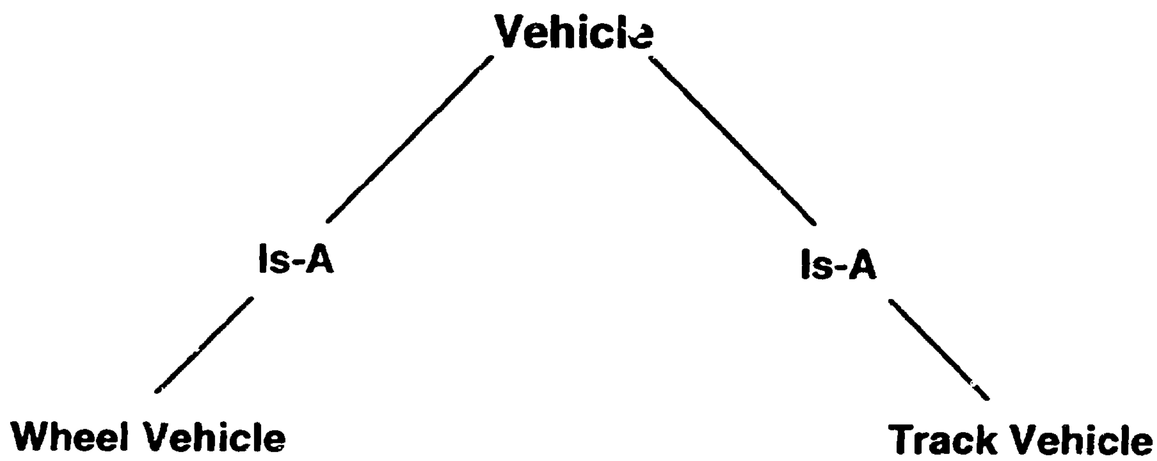
Categories of Data Meeting the Definition of Being "Complex" (Non-Exhaustive)

Inheritance ("is-a"): a relationship in which one or more subclasses "inherit" all the attributes and relationships of their superclasses.

Composition ("has a ", "is a part of"): data entities comprising instances of data which relate to other instances of data within the same entity.

Derivations ("comes from"): data that is computed from other data that is stored in the same or in other databases.

Inheritance ("Is-A")



- IDEF1X supports inheritance using the concept of category
- Complex data need more powerful notions of inheritance
  - Multiple inheritance: given class has multiple super classes: e.g., grad-student-assistant is subclass of student and employee both of which are subclasses of people
  - Multiple Is-A hierarchies: hierarchies have no common root (tank is a vehicle and tank is a weapon)
  - Polymorphic attributes: an attribute has different interpretations within subclasses of a common Is-A hierarchy (Vehicle-Speed expressed in different units of measure for different kinds of vehicles

Composition ("has a ", "is a part of")

Composition M&S data is awkward to represent using relational or IDEF1X concepts

- Directed graphs such as command hierarchies, bill of parts
- Construction/complex structures : such as road networks, compound documents
  - extensible set of data types: e.g., binary large objects (BLOBS)
  - chains: e.g., address made up of street, city, state, code
  - other types of construction

Derivations ("comes from") e.g., age, Pk

Algorithms

- Within instances: e.g., Age of a single PERSON
- Across instances (aggregations): Average-Age of all PERSONS
- Stated explicitly: e.g., J:=X**2+Z
- By reference: using Euler's equations (i.e., the internal workings of the algorithm are not described)

Complex Data Challenges

- Dependencies
  - Active: e.g., update Age each time Current-Date changes
  - Genealogy audit trail: Radar-Pulse-Repetition-Interval comes from EWIR version 1.5 last changes on 01 Jan 94
- Mapping ("maps to/from")
  - Inter-model: Radar-PRI in Model A is the same as Radar-Pulse-Interval in Model B
  - Intra-model: Age depends on Current-Date and Birth-Date
  - Conversion: Pulse-Repetition-Intrval in Model A is the reciprocal of Pulse-Repetition-Frequency in Model B
- Artifacts of legacy systems and physical constraints
  - Multipurpose: e.g., Vehicle-Capacity may contain either number of passengers or weight carrying capacity depending on vehicle type
  - Coupled: e.g., Sex-Marital-Code bundles information on a person's Sex and Marital-Status in a single data element

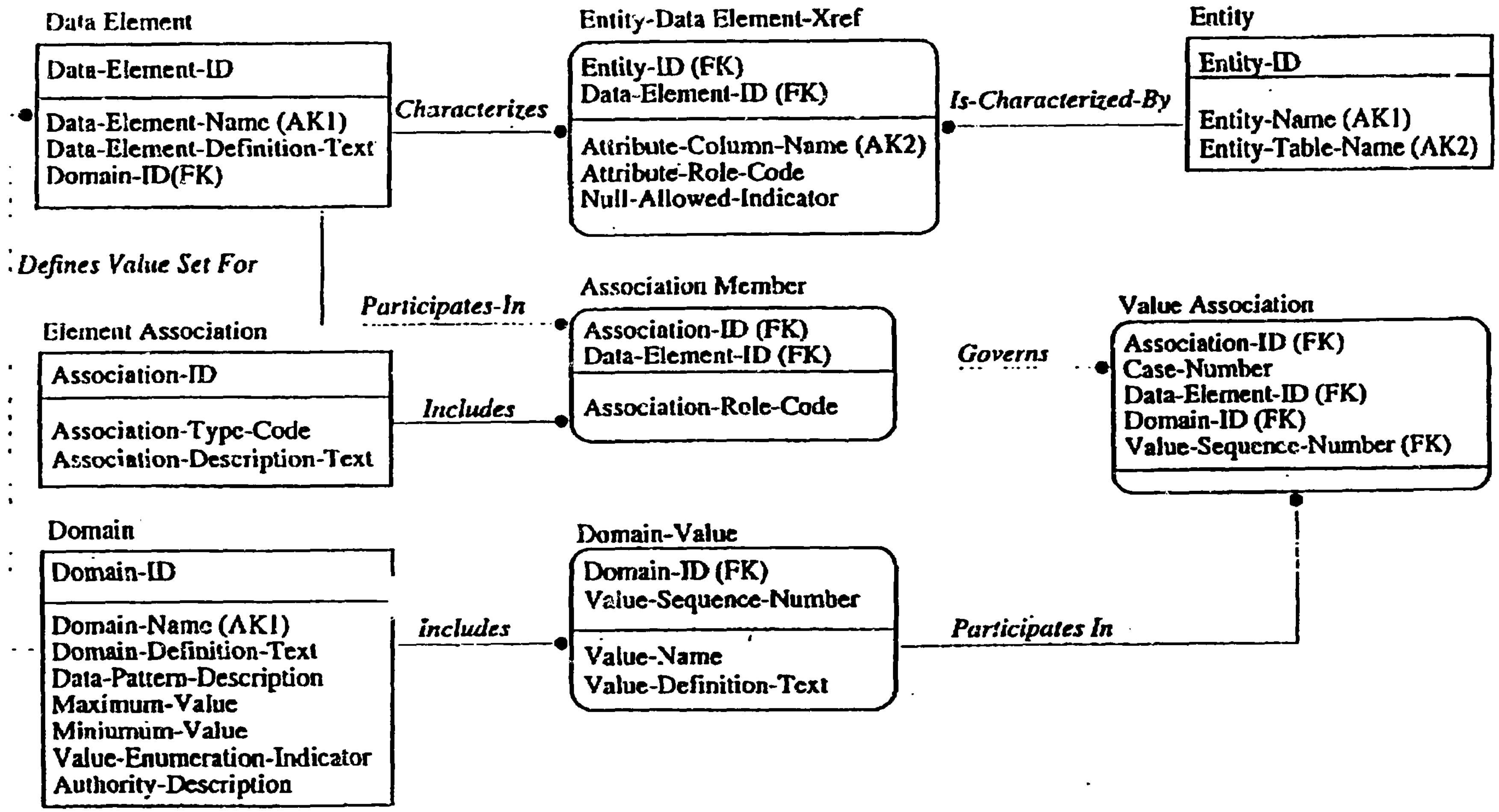
Items of Interest Since April 1994 Meeting

- DMA MC&G standardization effort funded by CIM is underway
- The DIRS model definitions paper has been delayed
- Workshop on Data Representations in Scientific Computation hosted by the Climate System Modeling Group at LLNL will be held at Villa Tassajara, Pleasanton, Calif., August 16, 1994

  "As scientific models are becoming more complex, various abstractions, schema, and information models are being proposed to deal with the increasing amount of semantic information required to make sense of model data. For example, such things as grid representations, geometry, units, and a host of parameters and attributes, are currently being incorporated into scientific DMSs and code development environments...purpose of workshop is to discuss strategies for representing scientific data in ways that would support building tools for DBMSs, development environments, visualization tools, and data archives."

- Duane Hufford's "Example metadata model for mapping domain collisions due to data element associations"

Example Metadata Model for Mapping Domain Collisions Due To Data Element Associations



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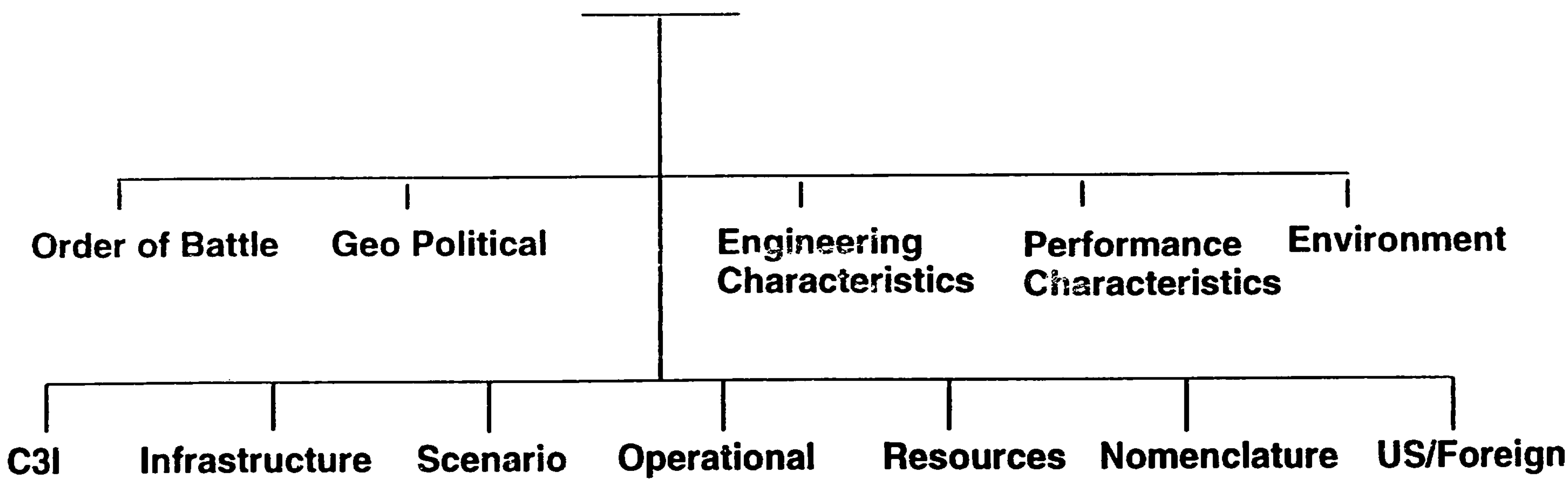
Taxonomies

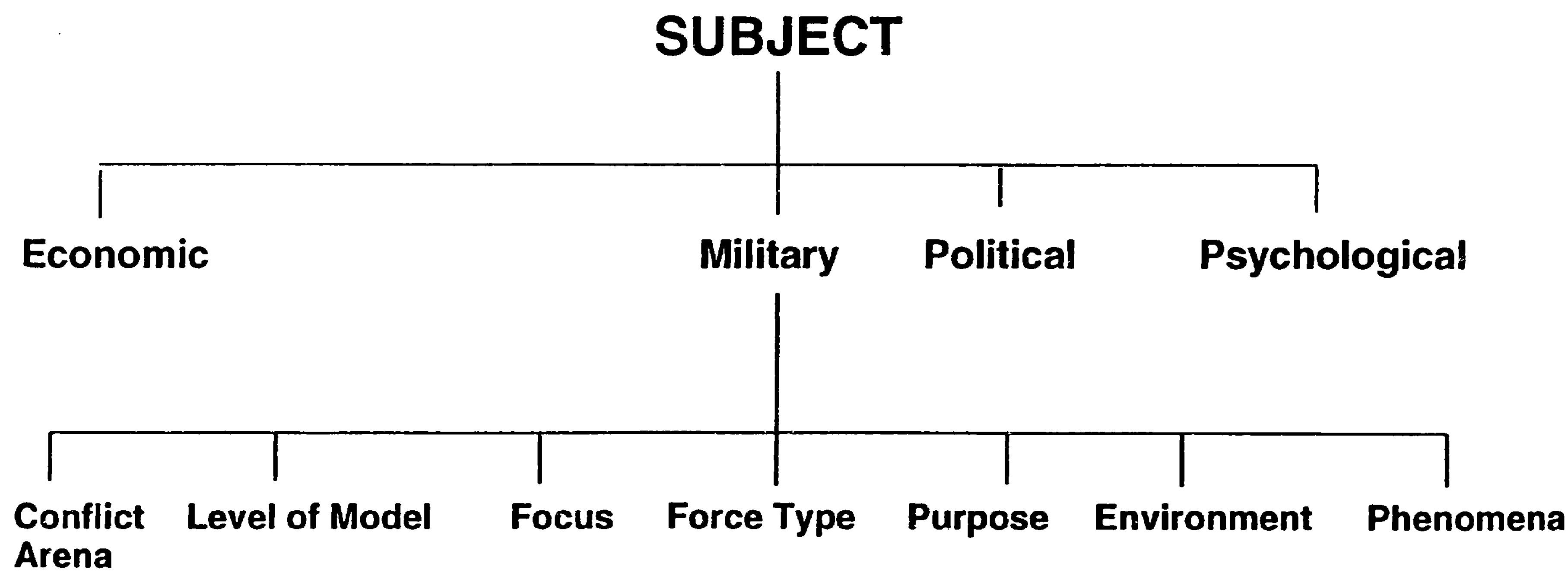
- Immediate need for taxonomies: Database Directory, M&S Directory, Authoritative Data Source categories
- There is a taxonomy Subgroup under the Complex Data Task Force co-chaired by Iris Kameny and LTCol Dan Hogg
  - no meetings have been held yet
  - RAND developed initial taxonomies for the directories (May 1994 email describing taxonomies and definitions)
  - TRAC took the Army M&S data categories and the RAND data taxonomy and integrated them into a taxonomy for Authoritative Data Source categories (June 1994 fax from TRAC describing taxonomy and definitions)

Draft Taxonomy for Database Directory (RAND)

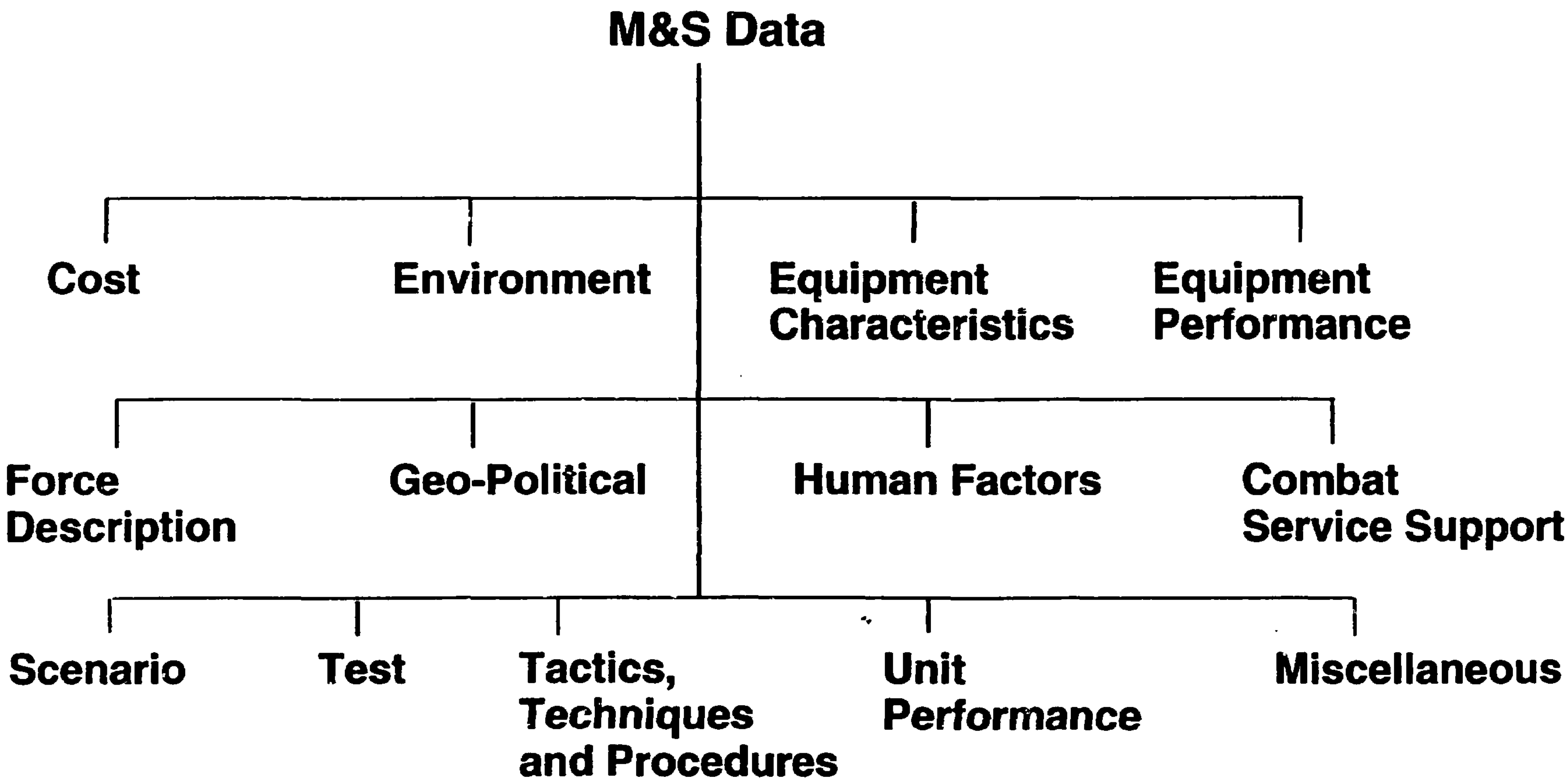
Categories of Information in Military Databases



Draft Taxonomy for M&S Directory (RAND)



Draft Modeling and Simulation Data Categories (TRAC) for use in Categorizing Authoritative Data Sources



Object Modeling: A Solution to Complex Data Challenges?

Elaine Ward

July 13, 1994

MITRE

Agenda

- Complex Data Challenges
- Object-Oriented as a Potential Solution
- Issues
- Summary

MITRE

Complex Data Challenges

- Most complex data challenges are a result of organizational dynamics and technological advancements.
  - Organizational dynamics affect policy, mission, and objectives, which, in turn, affect inter- and intra-organizational data.
    - Business process (domain) changes
    - Instance data changes
    - Mappings among different organizational and system models
    - Data dependencies or business rules
    - Data semantics inconsistences among models
    - Lack of normalization in legacy systems

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Complex Data Challenges (Concluded)

  - Technological advancements surface concerns relating to data integrity and synchronization
    - Heterogeneous, distributed environments
    - Data interoperability
    - Data sharing
    - User access privileges/ownership
- Challenges that result from organizational dynamics and technological advancements will not be solved by object modeling (or any other modeling technique).
- This briefing addresses how object modeling can be used to model complex data, relationships, and behavior.

MITRE

Complex Data

- Complex data is "that which is difficult or awkward to model using commonly used techniques."*
- Traditional modeling is static and usually associates primitive types with attributes.
  - Semantics are not captured.
  - Instances that do not relate to each other may be compared by accident.

* According to I/DBTWG Complex Data Task Force

MITRE

Complex Relationships

- Inheritance = "is a"
  - Multiple inheritance
- Composition = "has a" or "is a part of"
  - Hierarchies
    - Multiple "part of"
    - Command
    - Menu driven
  - Complex structures
  - BLOBs

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Agenda

- Complex Data Challenges
- ☛ Object-Oriented as a Potential Solution
- Issues
- Summary

MITRE

Key Aspects of Object Orientation

- Not really sure yet—ground is still settling
  - Object Management Group Object Model Task Force
- But most folks tend to agree that the following basic concepts are key:
  - Static characteristics :
    - Unique Identity
    - Encapsulation of data and behavior
    - Information hiding
    - Complex relationships, e.g., Inheritance
  - Dynamic characteristics:
    - Notion of state
    - Message passing
    - Well-defined interface (access through methods)
    - Polymorphism

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Definitions—Basic Concepts

1. Object—An entity containing attributes (set of data/ information) and behavior (set of functions/operations)
2. Encapsulation—Enforced association of attributes and behavior
3. Information Hiding—Hiding of implementation details
4. Class—Template that represents common instances
5. Inheritance—Ability of a class to inherit data and behavior from its parent
6. Message—Request from one object to another
7. Method—Operation executed in response to a message
8. Polymorphism—Ability of two or more classes to respond to the same message appropriately

MITRE

Object vs. Data Modeling

- There are important differences between data and object modeling.
- Purpose (Enterprise perspective)
  - Both models
    - Promote reuse and synchronization
    - Promote data sharing and system interoperability
    - Avoid stovepipe systems
- Focus/Scope (Systems development perspective)
  - Top-level object models tend to have a problem domain focus.
    - People and other organizational resources are often included.
  - Conceptual data models tend to focus on data that is to be stored in the database.

Object vs. Data Modeling (Concluded)

- Content
  - Depends on viewpoint or level of abstraction
  - Object models include problem domain classes, their behaviors, and relationships among the objects.
  - Data models include entities, attributes, and basic relationships.
    - Sometimes include mechanism for strong typing

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Entity vs. Class

Traditional Data Model	Object Model
Tank	**Tank**
id (numeric) code (alphanumeric) load capacity (numeric) fuel capacity (numeric) unit id (R) (numeric)	id (tank_id_type) code (tank_code_type) load capacity (tank_lc_type) fuel capacity (tank_fc_type) unit id (R) (unit_id_type) state (tank_state_type)

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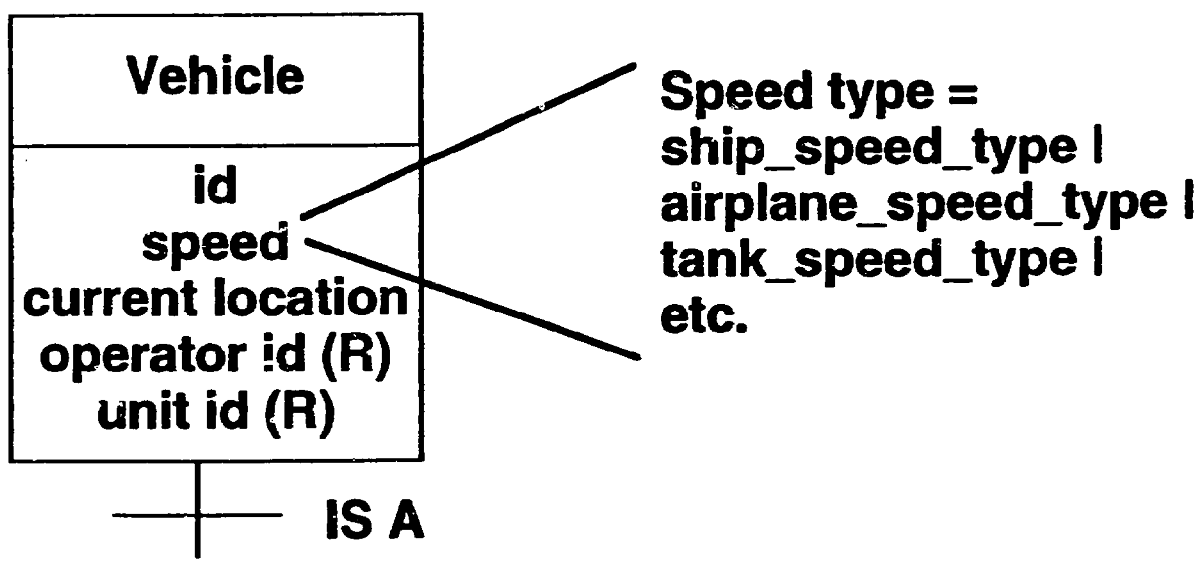
Inheritance and Polymorphism

- Multiple inheritance
  - *Tank* is a *Tracked Vehicle* and a *Land Weapon*
- Polymorphic attributes
  - Vehicle speed—*Ship* vs. *Airplane*
  - Can be accomplished through value restrictions on information types



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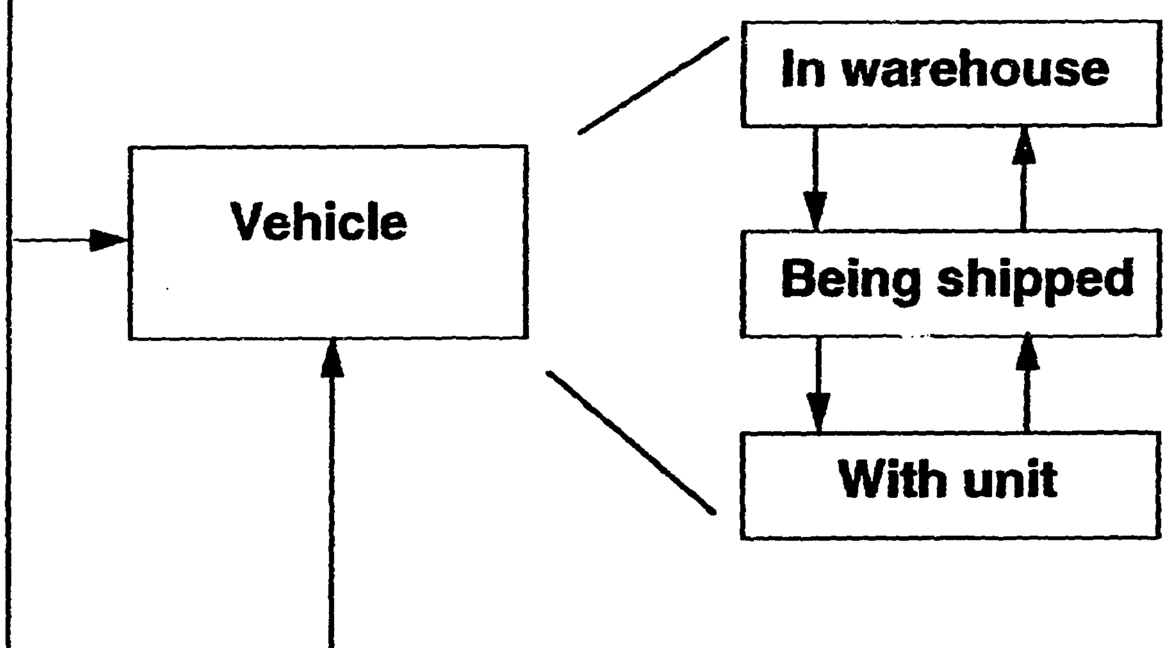
Behavior

- Ability to model data's behaviors
  - Traditional data modeling is static in nature.
  - Object modeling involves looking at both static and dynamic characteristics of the data.



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Agenda

- Complex Data Challenges
- Object-Oriented as a Potential Solution
- Issues
- Summary

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Objects Are in the Eye of the Beholder

- Object models can be used at the enterprise level, as well as in the analysis or design of systems.
- Objects may be used to represent large- or fine-grained information.
- Objects are abstractions that can be used to model various engineering viewpoints.
- Underlying object models used by various technologies are not necessarily compatible.

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Types of Object Models

- Object models can be used to represent different system or user views.
  - Enterprise or corporate level
  - Subject area (domain)
  - System architecture
  - Analysis and logical design
  - Physical design
  - Implementation
- Related models developed with different OO techniques may not map easily to each other.
- Related models developed with OO and non-OO techniques may not map easily to each other.

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Object Orientation at the Enterprise Level

- Enterprise object model
  - May contain objects, in addition to traditional data
  - Should contain behavioral aspects
  - Concern: How does it relate to Enterprise Data Model and Enterprise Business Process Model?
  - Should there be an integrated model?
- Example proponent: James Martin
- OMG Business Object Management SIG

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Object Orientation at the Subject Area (Domain) Level

- Domain model
  - Focus on reuse activities
  - Potentially useful in migration activities
- Concern: Gaining consensus on generic object models, hierarchies, and behaviors
  - Approach assumes that domain is well understood.
  - Important to include representatives from all user groups
- Concern: How to integrate a generic domain model with a specific organization's business process model
- DOD attempting to exploit this approach

Object Orientation at the Architecture/ Technology Level

- System architecture as assemblage of large-grained objects
  - Integration of legacy applications, COTS, and new components
  - Focus on message passing/data movement
  - Fits well with distributed systems
- Concern: Overhead and performance when messages deal with individual fine grained data
- Example technology: CORBA

Object Orientation at the Analysis and Logical Design Level

- Object model
  - Analysis model is refined into a design model.
    - (Or is it?)
- Concern:
  - How do these object models relate to enterprise models and architecture/technology models?
  - Method integration among analysis and design options
    - Granularity of objects
    - Representation of objects
- Example methods: Shlaer/Mellor, Coad/Yourdon, Booch, Rumbaugh, Jacobson

Object Orientation at the Physical Design Level

- Map from logical design to physical implementation technology
  - Map to OOP and OODBMS fine-grained data abstractions
  - Map to COTS for large-grained design
- Concern: Except for mapping for fine grained designs into OOP and OODBMS, there is little guidance available.
  - Can a logical design represent large-grained objects?
  - How does the logical design map to relational data models?
  - How does the logical design map to screens, dialogues, and transactions?
- Some guidance in layering provided by HOOD

Management and Organizational Impacts

- Planning and budgeting
  - Must plan for cost of training and tool acquisitions.
  - Benefits of OO accrue over time.
- Attaining resources
  - Few real experts or experienced personnel exist.
- Altering the project work breakdown structure
  - Must assume project team vs. separate analysis, design, and programming teams.
- Overcoming the learning curve
  - Must train entire program team.
- Managing and planning for reusability
  - Long-term planning essential to cost savings.
- Managing the shifts in user expectations
  - Best suited to interactive design and development.

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Agenda

- Complex Data Challenges
- Object-Oriented as a Potential Solution
- Issues
- Summary

MITRE

Observations about Object Modeling

- Mixing and matching OOA and OOD methods takes up-front work.
  - This is n[illegible] a seamless process.
- Establishment of a well-defined process must precede modeling activities.
  - What are you hoping to achieve?
  - What other models will the object model have to integrate with?
- Pilot activities help in identifying potential approaches.

Summary

- Object models provide significant enhancements to traditional data models.
- There are many different types of object models available.
  - Object modeling can be applied to different sizes of data and to model different viewpoints.
- In order to achieve potential benefits from OO
  - Proper tools must be selected for intended purpose.
    - Ensure methods and tools support process
  - Care must be taken to ensure that tools and methods have capability for integrating with complimentary process and implementation technologies.

Complex Data

DRAFT

C2 CORE DATA MODEL

Briefing to Modeling and Simulation IDB Meeting

12 July 1994

Dr. Robert P. Walker
Institute for Defense Analyses
rwalker@ida.org; 703-845-2462 (FAX -6722)

Key IDA Contributors: Dr. Gene Simaitis, Dr. Franciso Loaiza

Sponsorship of Data Modelling at IDA:

- DASD(IM) and Joint Staff J6V—GCCS and Integrated C2 Data Models (1994-95)
- U.S. Representative to ATCCIS [U.S. Army ODISC4, OASD(C3I)-T&TC3]— Generic Hub and Fire Support Data Model (1992-95)
- DISA/JIEO/TBCE (Information Directorate, Center for Standards)—Fire Suport Data Model and C2 Core Data Model (1992-93)

FOCUS OF BRIEFING

- ROLE OF DATA MODELS
- ENTERPRISE DATA MODEL
- C2 CORE DATA MODEL
- C2 SUBFUNCTIONAL AREA DATA MODELLING
- CHALLENGES FOR FUTURE C2 DATA MODELLING

PURPOSE OF DATA MODELS

- PROVIDE A HIGH-LEVEL SPECIFICATION OF:
  - Information inputs and outputs of functional processes
  - Information items subject to exchange (e.g., between staff cells)

- PROVIDE CONSISTENT BASIS FOR DATA ELEMENT STANDARDIZATION

OPERATIONAL BENEFITS

- DATABASES FOR C2 SYSTEMS
  - Consistent data standards lead to
    - Improved database design
    - Better accessibility
    - Potential for lower long-term system costs
  - Database-to-database exchange is key to operation of modern tactical C2 information systems
- INTEROPERABILITY
  - Consistent data standards provide necessary basis for specifying information exchange
    - Database-to-database
    - Messages, whether automated or manual
  - Integration of information exchange standards requires a common, consistent data model
    - TADILs
    - Message text formats
    - Variable message formats
    - Internal system exchanges (e.g., FACTs)

STANDARDIZATION POLICY

- DoD OPERATIONS SHALL BE EXECUTED THROUGH INTEGRATED AND STANDARD DEPARTMENT-WIDE
  - Processes
  - Data definitions
  - Information systems

  IN SUPPORT OF JOINT WARFIGHTING AND PEACETIME MISSIONS (DoD INSTRUCTION 8020.1)

- DATA STANDARDIZATION SUPPORTS (DoD 8320.1, 8320.1-M-1)
  - Providing clear, concise, consistent, unambiguous, easily accessible data DoD-wide
  - Minimizing the cost and time required to transform, translate, or research differently described, but otherwise identical, data
  - Data sharing and interoperability among information systems throughout the DoD
  - Uniform description and representation of data

- DATA ELEMENT STANDARDIZATION (DoD 8320.1-M-1)
  - Designed to represent the attributes (classification) of data entities identified in data models
  - Definition based on data entities and their associated attributes established in the DoD Data Model
  - Reflects a single concept to promote shareability and data independence for application

SCOPE OF DATA MODELS

- DATA MODELS DO NOT LIMIT THE CHOICE OF REPRESENTATIONS FOR:
  - Storing data physically in a system (e.g., database structure)
  - Presenting data to users (human-computer interface)
  - Presenting data to communications systems (e.g., protocols)
  - Exchanging data internally within an automated system

- DATA MODELS DO NOT LIMIT THE CHOICE OF LANGUAGE FOR
  - Users (e.g., French, English)
  - Programmers
  - Database query

RELATION TO ZACHMAN'S FRAMEWORK FOR INFORMATION SYSTEMS ARCHITECTURE

		DATA	FUNCTION	NETWORK
REQUIREMENTS	Objectives/ Scope	What is important to know?	What processes are performed?	Where are the operations conducted? (C2IEs, OPFACs)
	Model of the Business	Entities and relationships	Data flows (input, output) [USAFAS Red Book]	Nodes and links (need lines) [FIA]
	Model of the Information System	Conceptual Data Model - Entities - Relationships - Attributes (and keys) [IDEF1X]	Activity Model - Processes - Input/Output - Controls - Mechanisms [IDEF0]	Distributed (System) Architecture
IMPLEMENTATION	Technology Model	Data Design (database specification)	Structure Chart & Detailed Design Specifications	System Architecture (with hardware specifications)
	Detailed Representations	Data Design Description (fields, addresses)	Program Description (code, documentation)	Network Architecture Specifications (addresses, processes)
	Functioning System	e.g., DATA	e.g., FUNCTION	e.g., COMMUNICATIONS

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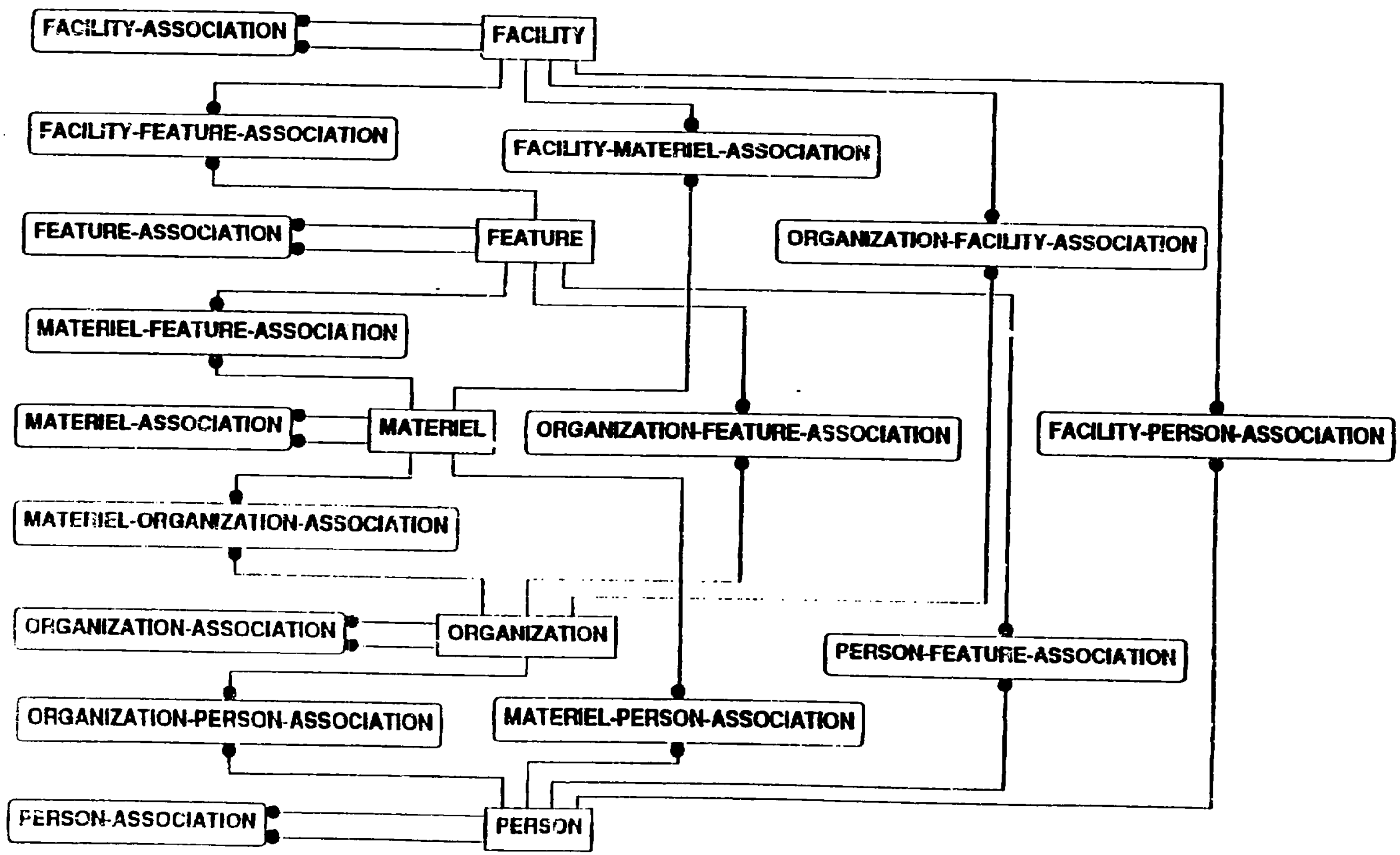
8. C2 CORE–ASSOCIATION EXAMPLE VIEW



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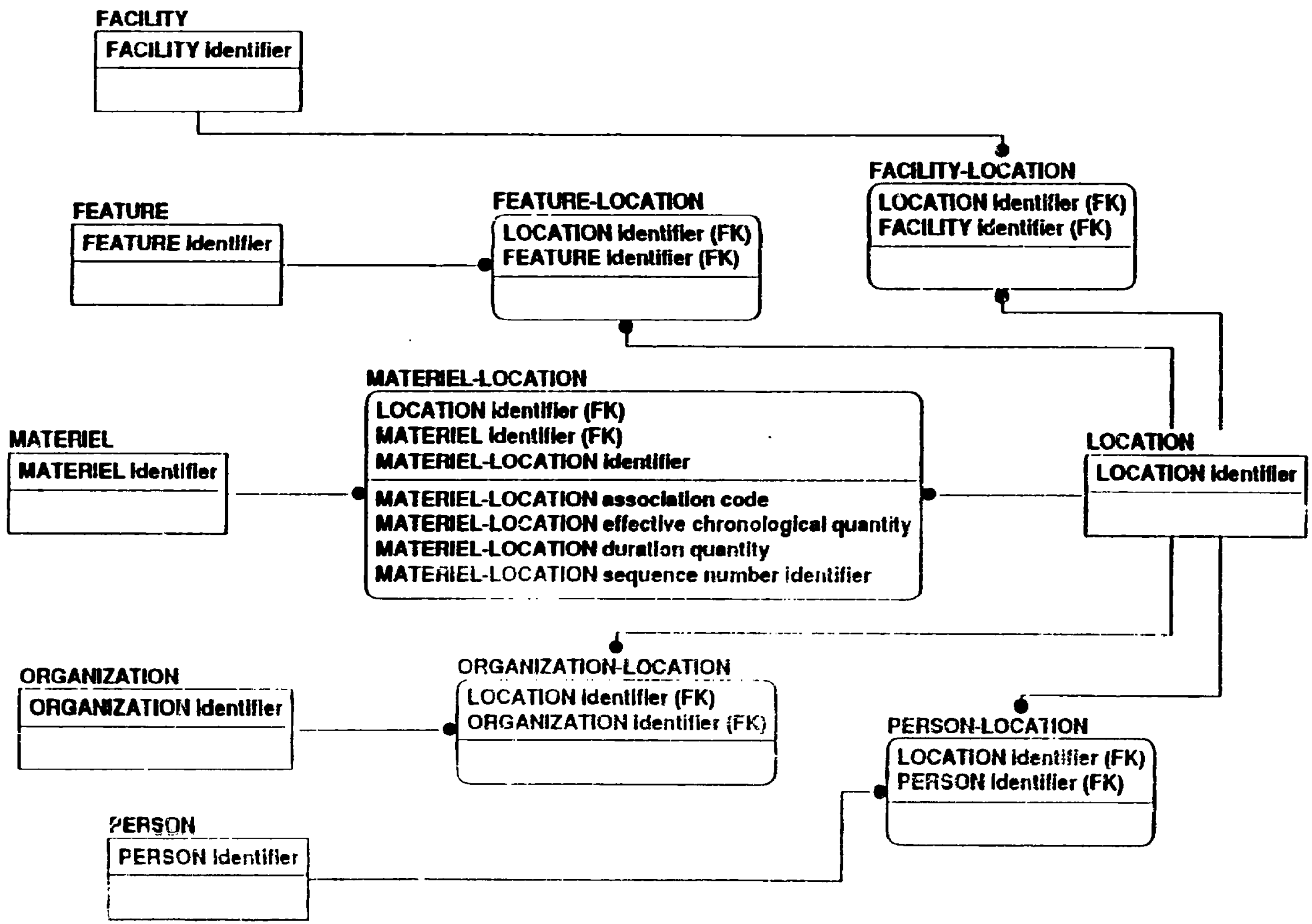
9. C2 CORE–LOCSATION ASSOCIATION VIEW

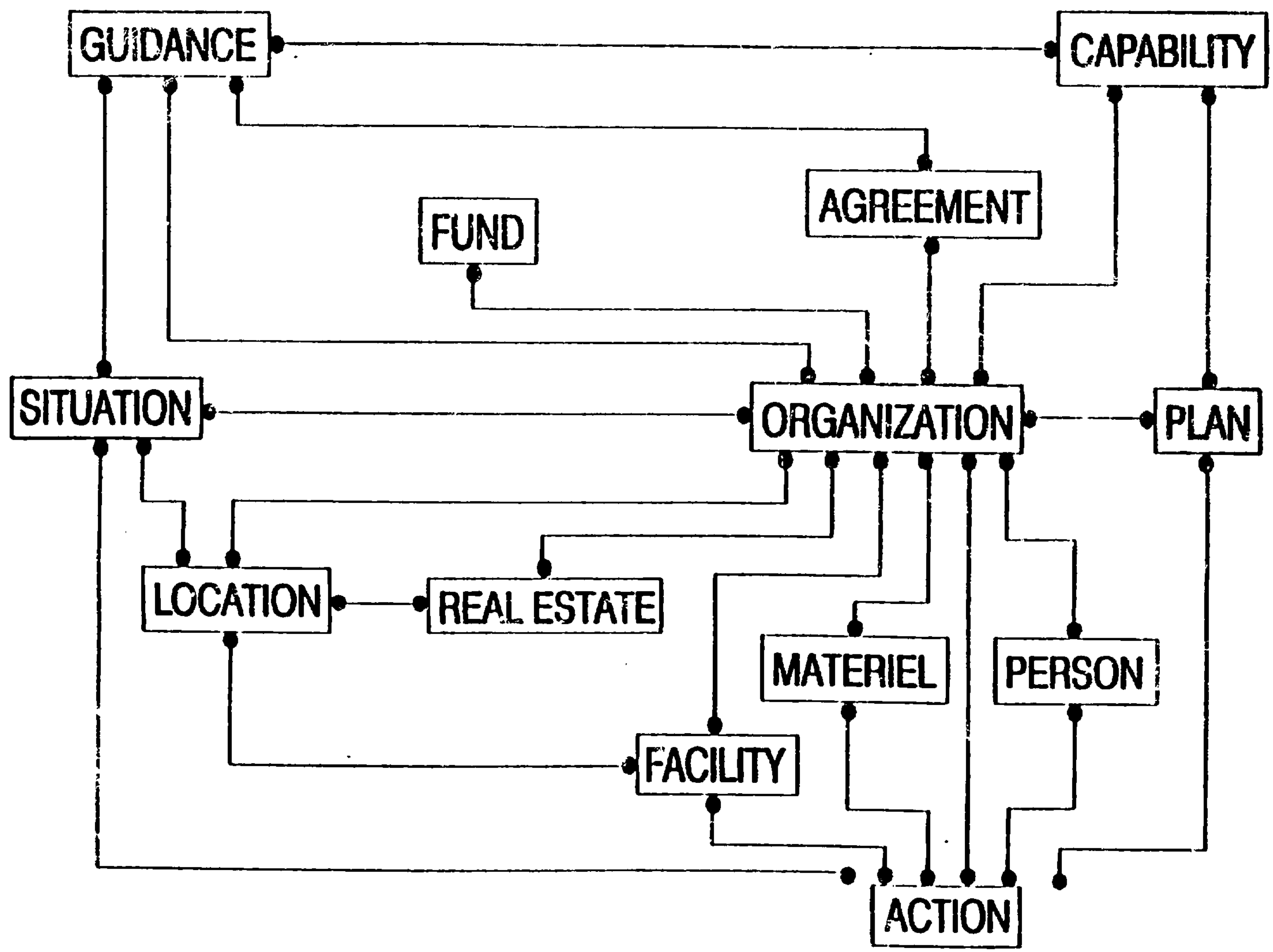


ROLE OF DoD ENTERPRISE MODEL

- PROVIDES A DEFENSE ENTERPRISE-LEVEL VIEW OF THE DoD DATA MODEL
- DoD DATA MODEL IS A SINGLE INTEGRATED DATA MODEL FOR THE DoD
- DoD DATA MODEL CONSISTS OF APPROVED ENTITIES AND ATTRIBUTES UNDER DoD 8320.1-M-X PROCEDURES
- EDITION 2 OF THE ENTERPRISE MODEL (JAN 94) SHOWS HOW FEATURE, POINT, LINE, AREA, VOLUME, CAPABILITY-NORM, AND DOCUMENT CAN BE INTEGRATED INTO THE DoD DATA MODEL
- QUARTERLY EDITIONS OF DoD DATA MODEL ARE PLANNED (BEGINNING JUNE/JULY 1994)

* JIEO/DAPMO INTEGRATES C2 AND OTHER FUNCTIONAL AREA DATA MODELS INTO THE DoD DATA MODEL

STRUCTURE OF DoD ENTERPRISE MODEL



BACKGROUND FOR C2 CORE

- MANDATED BY THE MILITARY COMMUNICATIONS-ELECTRONICS BOARD OF THE JOINT STAFF
- DEVELOPED BY DISA WITH SUPPORT FROM ODISC4 AND CONTRACTORS; RELEASED 1 SEP 93
- EXCLUDES OBJECT-ITEM AND OBJECT-TYPE TO SIMPLIFY INTEGRATION TO THE DoD DATA MODEL
- PROVIDED TO C2 COORDINATION COMMITTEE (CDAds, FDAds, AND OTHERS) FOR REVIEW IN FALL 1993
- HAS BEEN RECOMMENDED FOR USE BY EXECUTIVE AGENTS FOR C2 FDAd AND INTEL FDAd (AND US ARMY ODISC4)

* SERVES AS A CORE FOR MODEL DEVELOPMENT AND INTEGRATION

CONCEPTS UNDERLYING C2 CORE DATA MODEL

- FOCUS SHOULD BE ON DATA FOR THE ELEMENTS OF THE BATTLEFIELD AND THEIR EMPLOYMENT (ACTIONS)
  - Battlefield elements (OBJECTs) comprise: PERSON, UNIT, MATERIEL, FEATURE, FACILITY
  - Activities employ objects both as resources and as objectives: "Use these objects against these objects (targets)"
  - Battlefield objects occur both generically (by type) and specifically (by item)
    - -- To specify targets
    - -- To describe what is established (e.g., for a unit) and what is actually held
    - -- To describe what is needed and what is allocated to carry out a plan to achieve an objective

CONCEPTS UNDERLYING C2 CORE DATA MODEL (Cont'd)

- FOCUS SHOULD BE ON DATA FOR THE ELEMENTS OF THE BATTLEFIELD AND THEIR EMPLOYMENT (ACTIONs) (Cont'd)
  - Objects can be located in a single way (LOCATION)
  - Activities can be grouped and structured (as ACTIONs) to specify:
    - Subactions, modified actions, and (time) dependent actions
    - Plans, orders, and requests (e.g., fire plan)
    - Events
- THERE IS A COMMON CORE ("C2 CORE") UNDERLYING THE C2 FUNCTIONAL AREA
  - If specified in one way, the core could provide a basis for integrating subfunctional areas
  - Fire Support Data Model is first extension of the common core
  - A single data model is possible (with many user views)

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Challenges

COORDINATION OF C3I MODELLING EFFORTS

- BRINGING TOGETHER M&S WITH C2 AND INTELLIGENCE INTIATIVES
- INTEGRATING COMMUNICATIONS-ELECTRONICS AND ENVIRONMENTAL DATA MODELLING
- EXPANDING THE C2 CORE AS NEW CORE REQUIREMENTS EMERGE
- INTEGRATING ENTIRE C2 FUNCTIONAL AREA INTO ONE C2 DATA MODEL
- SUPPORTING DEVELOPMENT OF GCCS DATA MODEL
- ACCELERATING MODEL INTEGRATION
- ACCELERATING DATA STANDARDIZATION
- MAINTAINING FOCUS ON DEVELOPERS AND USERS

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C2 Subfunctional Area Data Models

FIA DATA MODELS

- CHARACTERIZE INFORMATION COVERED BY FUNCTIONAL INTEROPERABILITY ARCHITECTURES DEVELOPED BY JIEO AND VALIDATED BY JOINT STAFF
  - Fire Support
  - JTF Operations Control
  - Air Defense and Airspace Control
  - Land Combat Operations
  - Intelligence
  - Air Operations
  - Special Operations
  - Combat Service Support
  - Maritime Operations
- FOCUS ON JOINT AND COMBINED INFORMATION EXCHANGES BASED ON NEED LINES IDENTIFIED IN THE FIAs

C2 SUBFUNCTIONAL DATA MODELLING

- PROGRESS IS BEING MADE
  - Fire Support: Review completed Aug 94; data std. begun
  - JTF Operations Control: GCCS data modelling just begun
  - Air Defense and Airspace Control: Underway
  - Land Combat Operations: ATCCS prototyping effort underway
  - Intelligence: C2 Core is being promoted; other efforts underway
  - Air Operations: Initial data model (air tasking order) done
  - Special Operations: Initial data model done
  - Combat Service Support: Integration of JOPES LDM and C2 Core
  - Maritime Operations: Initial NWTDB data model (draft)
- MANY OF THESE ARE NOW BASED ON C2 CORE (Fire Support, GCCS, Air Defense, ATCCS, Intel, NWTDB); OTHERS SOON TO COME
- WORK ON LOCATION, FEATURE, METOC, AND COMM-ELECTRONICS IS UNDERWAY; MANY EFFORTS ARE FOCUSED ON C2 CORE

STANDARDS FOR DOCUMENTATION AND ANALYSIS

- DOCUMENTATION
  - High-level IDEF0 activity model with diagram and definitions
  - IDEF1X diagram
  - Attribute and entity defintions (with indications of sources)
  - Relationship table ("business rules")
  - Example domains with cross references to current standards
  - Description of methodology*

- ANALYSES
  - Entity-by-entity description with instance tables
  - Relation of activity model and data model
  - Specification of common C2 products in terms of data model with instance tables
  - Element-by-element analysis of degree to which each element of data in current use is supported by the data model
    - Interoperability standards (multinational and joint)
    - Service data requirements
    - System specifications
  - Integration to DoD Enterprise Model
  - Relation to DoD policy, guidelines, and architectures (e.g., FIAs)

Challenges

APPLICABILITY TO DATA STANDARDIZATION ACTIVITIES

- POTENTIALLY A FOCUS FOR DoD MESSAGE DEVELOPMENT ACTIVITIES
  - U.S. MTFs
  - NATO STANAG 5500/ADat P-3 MTFs

- POTENTIALLY A BASIS FOR COMMON DoD/NATO DICTIONARY
  - TADILs
  - MTFs
  - Other messages (e.g., VMF)
  - Non-message-based exchanges

Challenges

CAUTION ON APPLICABILITY

- DATA MODELS TAKE TIME TO DEVELOP, VALIDATE, AND INTEGRATE

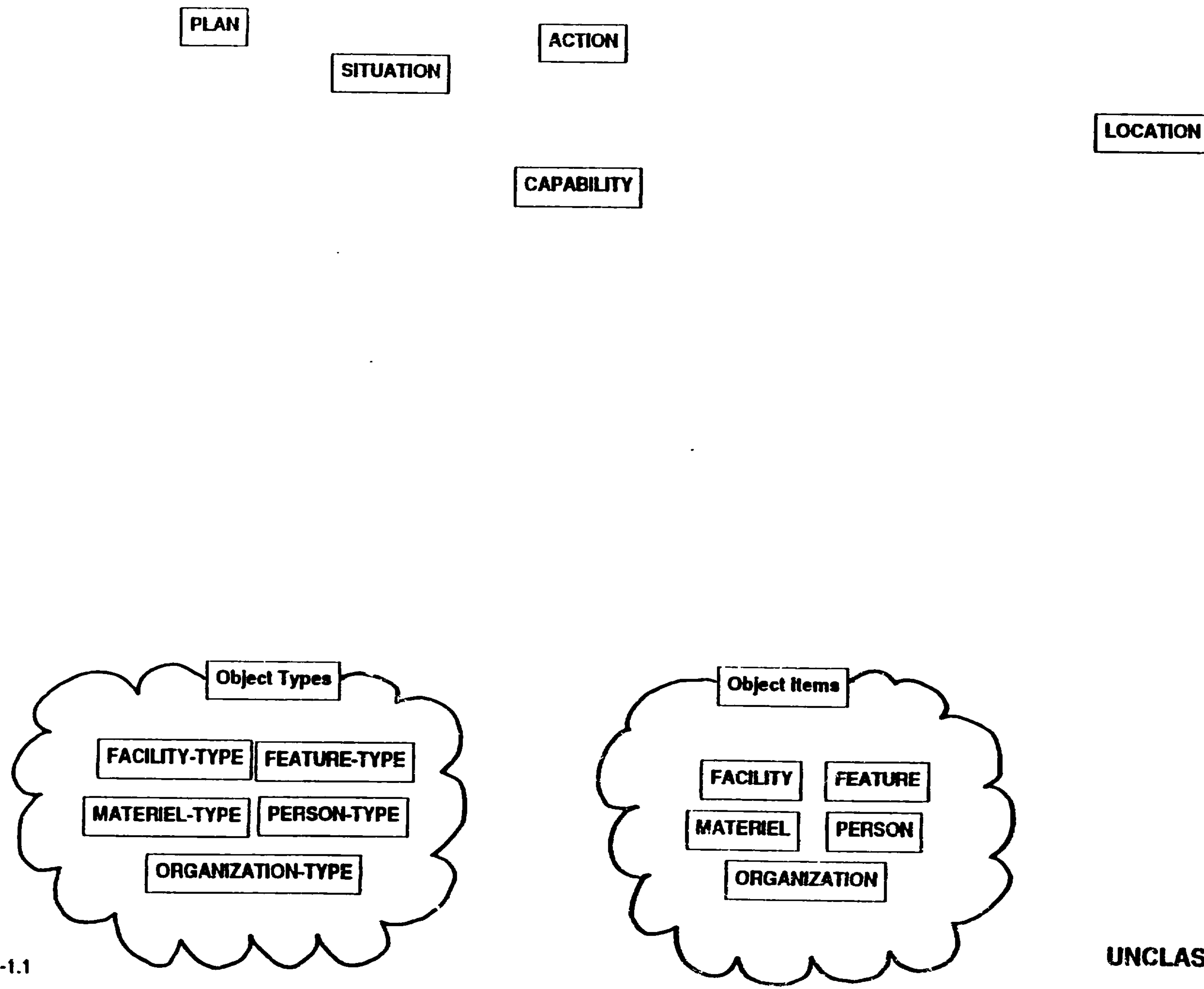
- HEAVY INVESTMENT IN EXISTING MESSAGES WILL REQUIRE TIME AND RESOURCES TO EFFECT A TRANSITION
  - Transition strategy needs to be carefully developed with clear priorities
  - Centralized leadership is needed to focus DoD activities

- MAJOR IMPACT IS LONG-TERM, WITH POTENTIAL MID-TERM BENEFITS IN SELECTED AREAS

CANDIDATE ELEMENTS OF A C2 DATA MIGRATION STRATEGY

Element	Status/Product	Time Frame	Relation of Product to GCCS and Integrated C2 Data Model
DoD Enterprise Model	Revision released	Feb 94	Basis for integrating C2 with other DoD functional areas (a single DoD data model is needed to ensure consistent data elements)
DoD Data Model	Ongoing; quarterly revision planned for mid-July 1994	Ongoing	Records structure of approved entities and attributes; basis for DoD model integration
GCCS Data Architecture Report	Draft Version 1.2 completed by DAPMO	15 Feb 93	TBD: Identifies clusters that can be used to prioritize work
GCCS Data Migration Strategy and Standardization Plan	Draft completed by DAPMO	28 Feb 94	TBD
GCCS Data Modelling	New tasking for IDA directed by J6V	Initial Report Dec 93; drafts bimonthly	Expanding C2 Core Data Model to develop GCCS Data Model, incorporating other data modelling products where applicable; integrated to the DoD Data Model
Starter Set of Data Elements)	Version 0.1 completed by JIEO/CFS	1 Dec 93	Candidate interim data elements (not model based)
C2 Core Data Model	Completed by DISA at direction of MCEB; available for use; revision planned Jun 94	1 Sep 93	Candidate starting point for GCCS Data Model and for integrating all C2 data models
Global C2 Process Improvement Study	Final Report by Joint Staff and Services team	15 Jan 93	Identifying information exchange requirements; prioritization
Joint Operation Planning Process Improvement Conference	Final Draft Report	14 Jan 93	Identifying information exchange requirements; prioritization
JOPES Logical Data Model	Contains IDEF0 Views of JOPES data; technical integration to C2 Core and DoD Data Model evaluated by DAPMO	30 Sep 93	Expanding C2 Core; early work on technical integration focuses on preserving existing LDM structure and introducing non-identifying relationships to entities in C2 Core
Scheduling and Movement (S&M) Physical View of JOPES data	IDEF1X specification of a physical schema based on JOPES LDM for mid-term GCCS capability	30 Sep 93	Expanding C2 Core
USPACOM Crisis Action Planning and Execution Preliminary Economic Analysis	Preliminary Draft (data model in Annex F uses Generic Hub/C2 Core)	30 Sep 93	Expanding C2 Core; identifying information exchange requirements

1. C2 CORE–INDEPENDENT ENTITIES



CANDIDATE ELEMENTS OF A C2 DATA MIGRATION STRATEGY (CONT'D)

Fire Support Data Model	Completed by IDA for JIEO/CFS/C3I Supp Div	Aug 93	Expanding C2 Core for fire support C2 subfunctional area
Air Operations Data Model	Draft focused on ATO messages completed by multi-Service group led by JIEO	3 Sep 93	Expanding C2 Core for ATO portion of air operations C2 subfunctional area
SOCOM Data Model	Draft focused on readiness completed by SOCOM	20 Aug 93	Expanding C2 Core
Joint Meteorology/Oceanography (METOC) Process Modelling	Final Report contains top-level producer view of METOC products	19 Apr 94	TBD
METOC Conceptual Data Model	Review draft; integrated to C2 Core	22 Dec 93	Expanding C2 Core (e.g., MET-FEATURE and other GEOPHYSICAL-FEATUREs)
Naval Warfare Tactical Data Base (data specification)	Standard by N62 provides IDEF0 views and early version of integrated data model; Version 2 released June 1992 addresses OSS and NTCS-A	Ongoing	Expanding C2 Core for maritime operations C2 subfunctional area
Army Tactical Command and Control System (ATCCS) data modelling and prototype system	Implemented C2 Core with displays for force level control	Ongoing	Expanding C2 Core for land combat operations C2 subfunctional area
Army Tactical Command and Control Information System (ATCCIS) data modelling for Battlefield Generic Hub and extensions for fire support, communications-electronics, personnel, and barriers-engineering	Generic Hub (April 1993) and Generic Hub Level 2 (planned for July/August 1994); multinational (10 NATO nations);	Ongoing	Generic Hub was original basis for defining C2 Core; work during last 13 months can be used to expand the C2 Core; GCCS model could be used to form US positions for ATCCIS
CIM Modeling Study of DoD Management and Use of the Electromagnetic Spectrum	Interim Report by the J208Z Permanent Working Group	Aug 93	TBD
Digital Geographic Information Exchange Standard (DIGEST) Specification	Multinational activity; DMA has US lead; Edition 1.2	Jan 94	Expanding concept of feature

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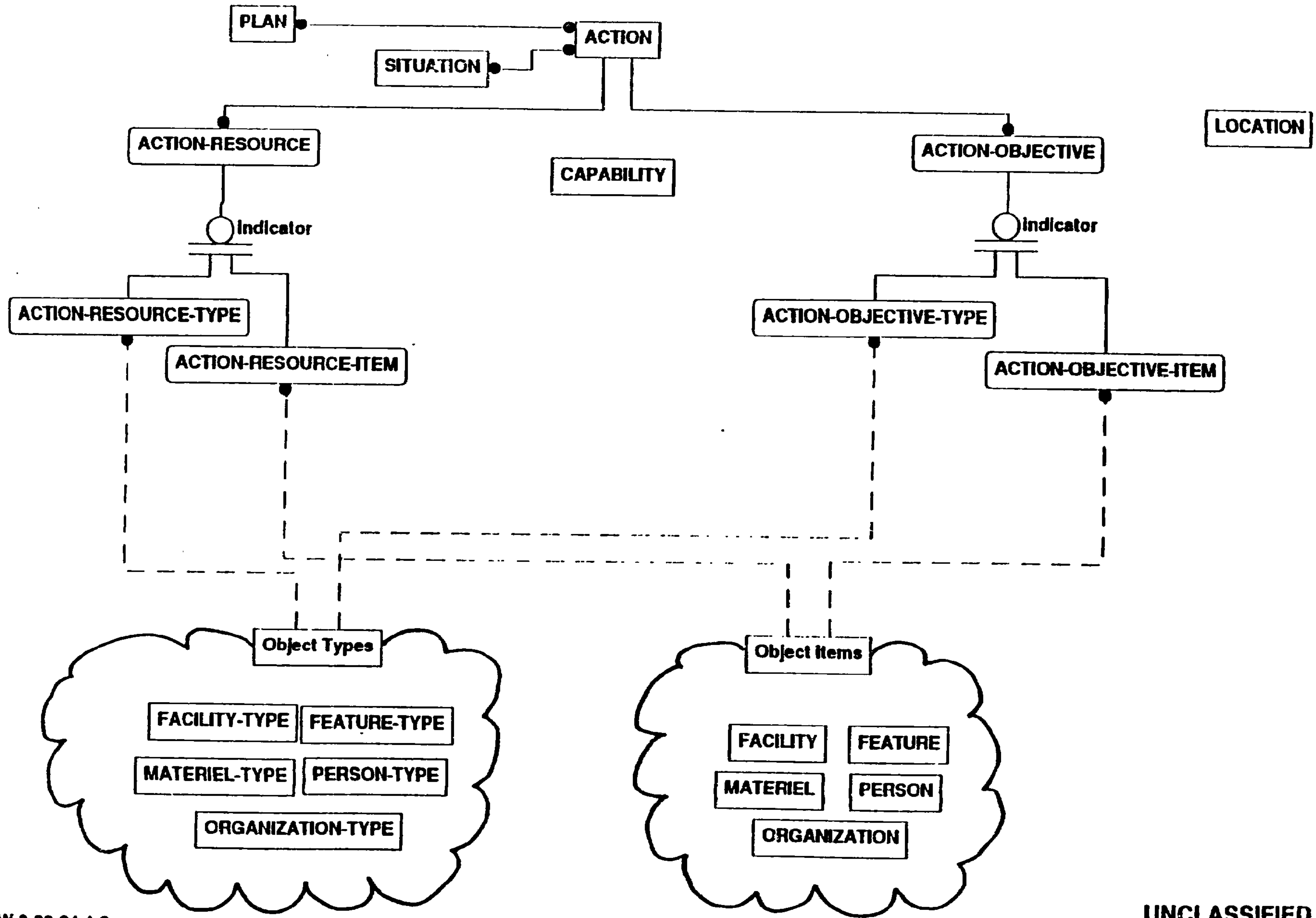
2. C2 CORE–RESOURCE AND OBJECTIVE



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3. C2 CORE–LOCATION AND TARGET

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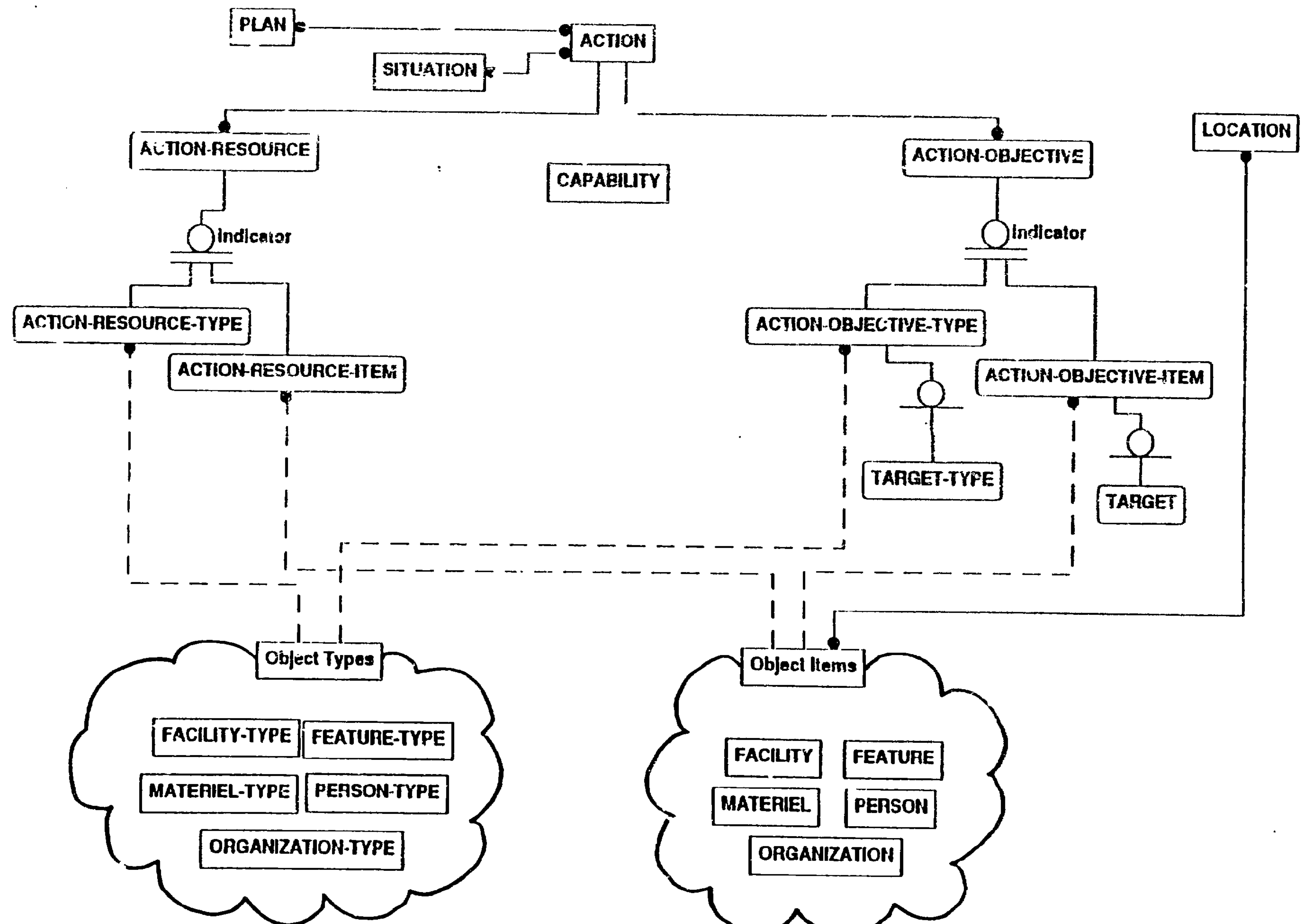

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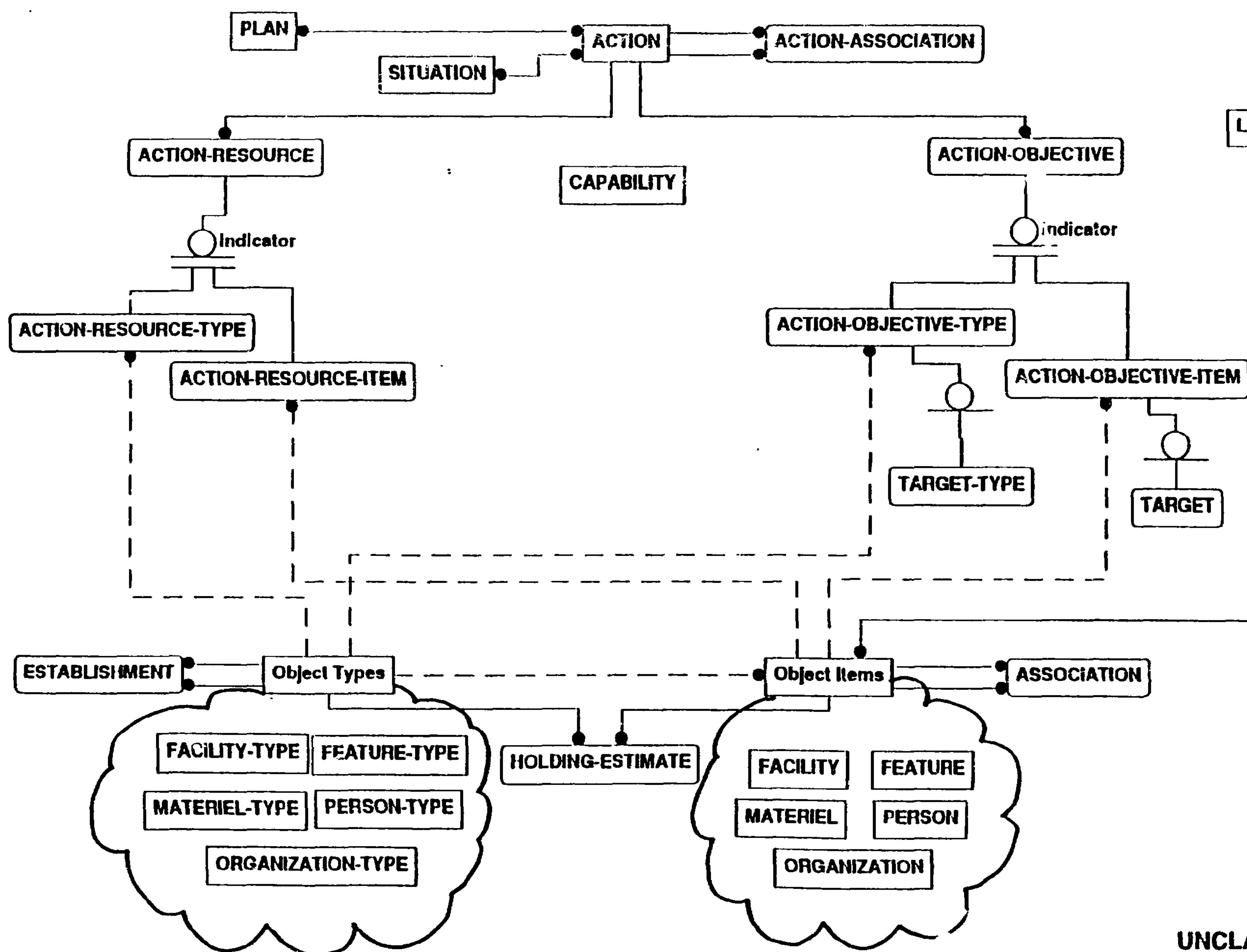
4. C2 CORE–ASSOCIATIONS



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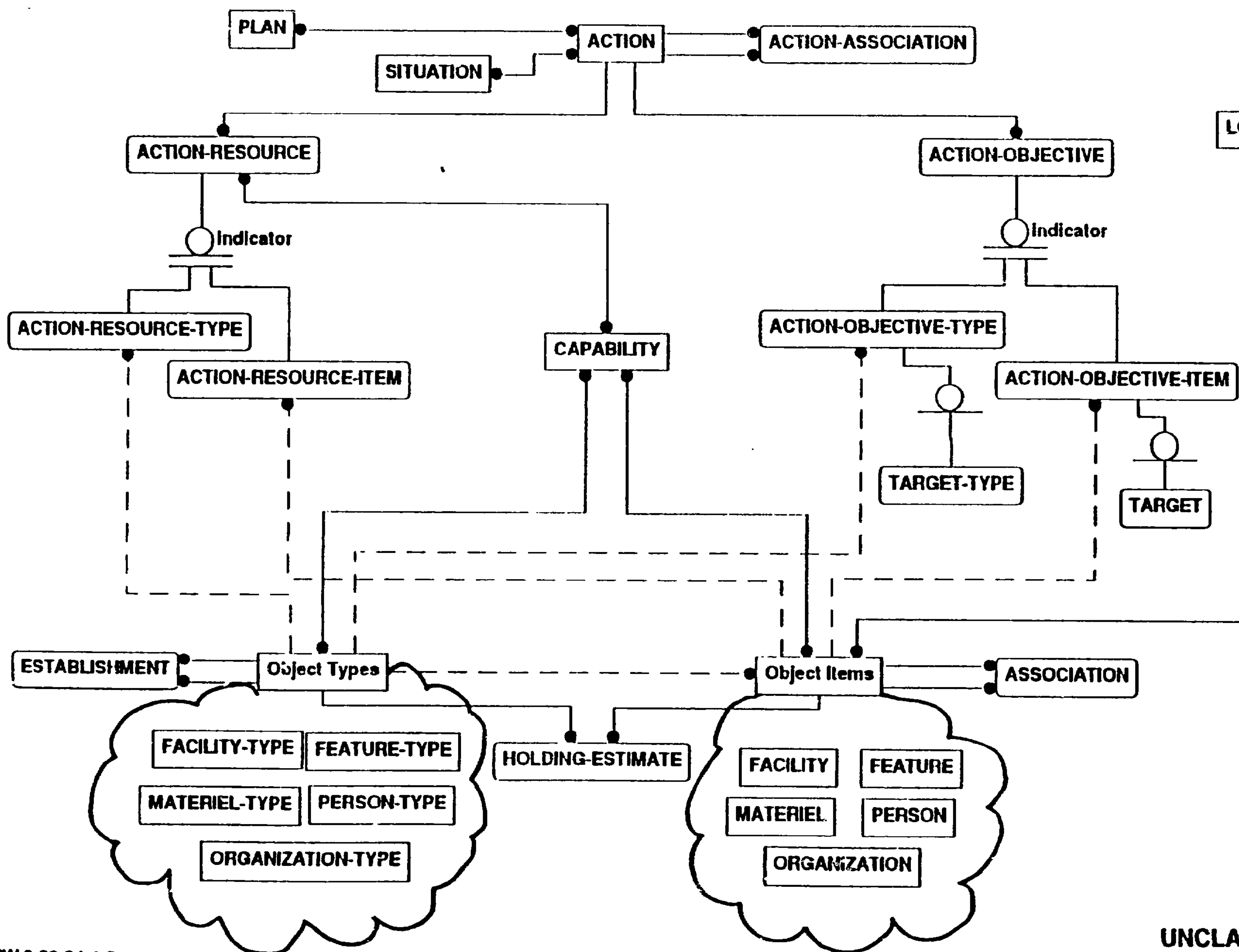
5. C2 CORE--CAPABILITY



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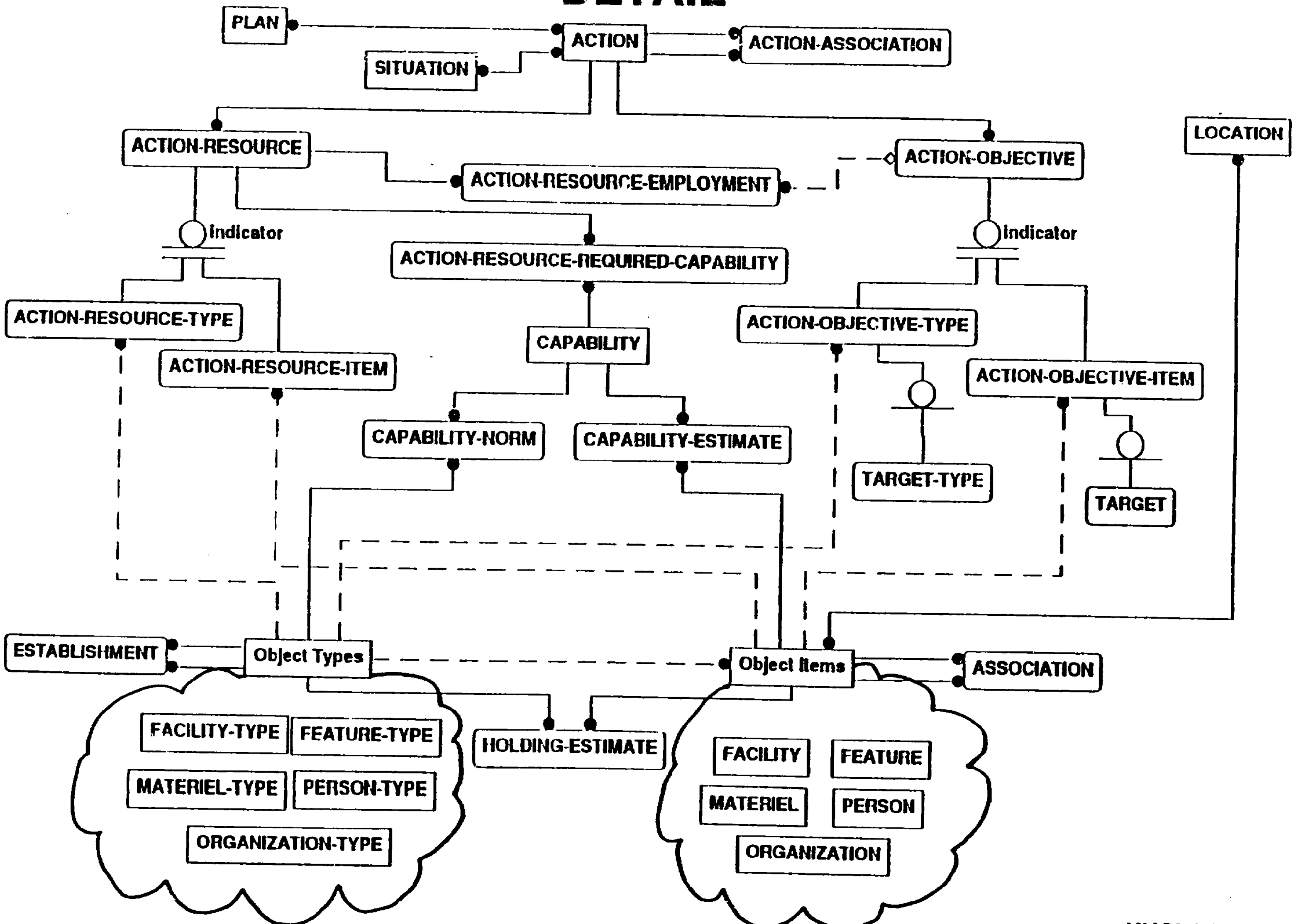
6. C2 CORE–EMPLOYMENT AND CAPABILITY DETAIL



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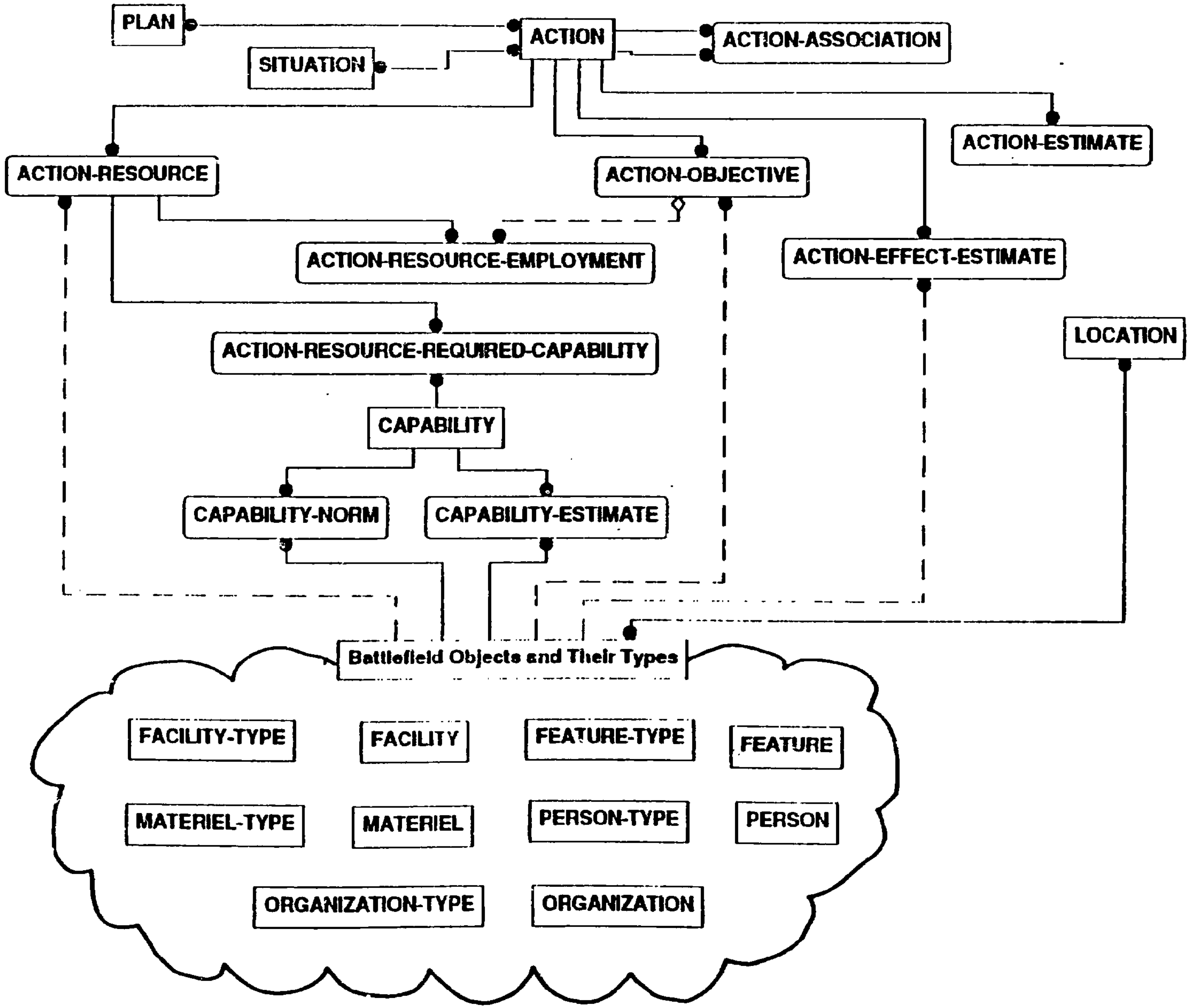
7. C2 CORE–ACTION ESTIMATES



National Ground Intelligence Center Brief
(Janet Morrow

NGIC

GROUND SYSTEMS

AAA
Ammunition
Armored vehicles
Artillery
Bridges
CCD
Chemical
C3
Detection devices
Explosives
Engines
Electronic Warfare

Radar
C3 Networks
Land navigation
Mine/LCounterMine
MHE
Petroleum
Small arms
Smoke
Rotary Wing
Trucks
Water supply

ARTILLERY

Self-propelled cannon
Towed cannon
Self-propelled rocket launcher
Towed rocket launcher
Mortars

NGIC

ARTILLERY DATA GROUPS

System characteristics
Defensive armament/ammo
Country/Plant info
Deployment
Use/niche
Signature
Countermeasures
APU
Lower carriage
Engine
Physical description
Armor
Firing data
Mobility data
Logistics
Prime mover
Fire Control
Sensors
CBR
Crew

CANNON SPECIFIC

Cannon tube
Projectile
Charge-set
Charge constituent
Muzzle velocity/range
Projectile ballistic performance
Payload
Projectile fuze interaction
Mine projectile interaction
Submunition projectile interaction

NGIC

META DATA

Security classification

Confidence Level

Comments

Minimum value

Maximum value

Date of information

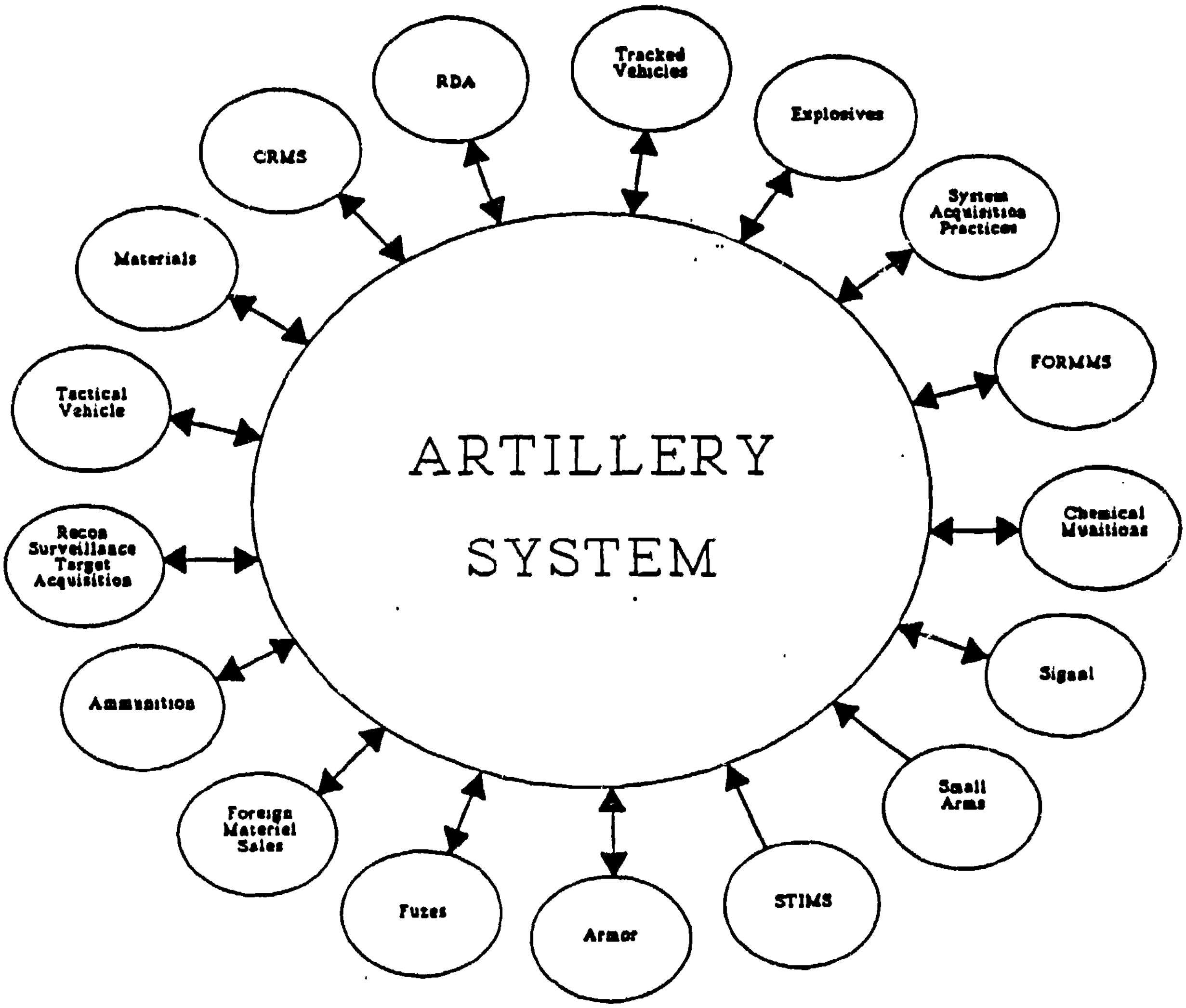


Figure 4. Contextual View of the Artillery Information Model

NEED MULTIMEDIA

Graphs

Charts

Videos

Rules of employment (text vs. parameters)

Acoustics

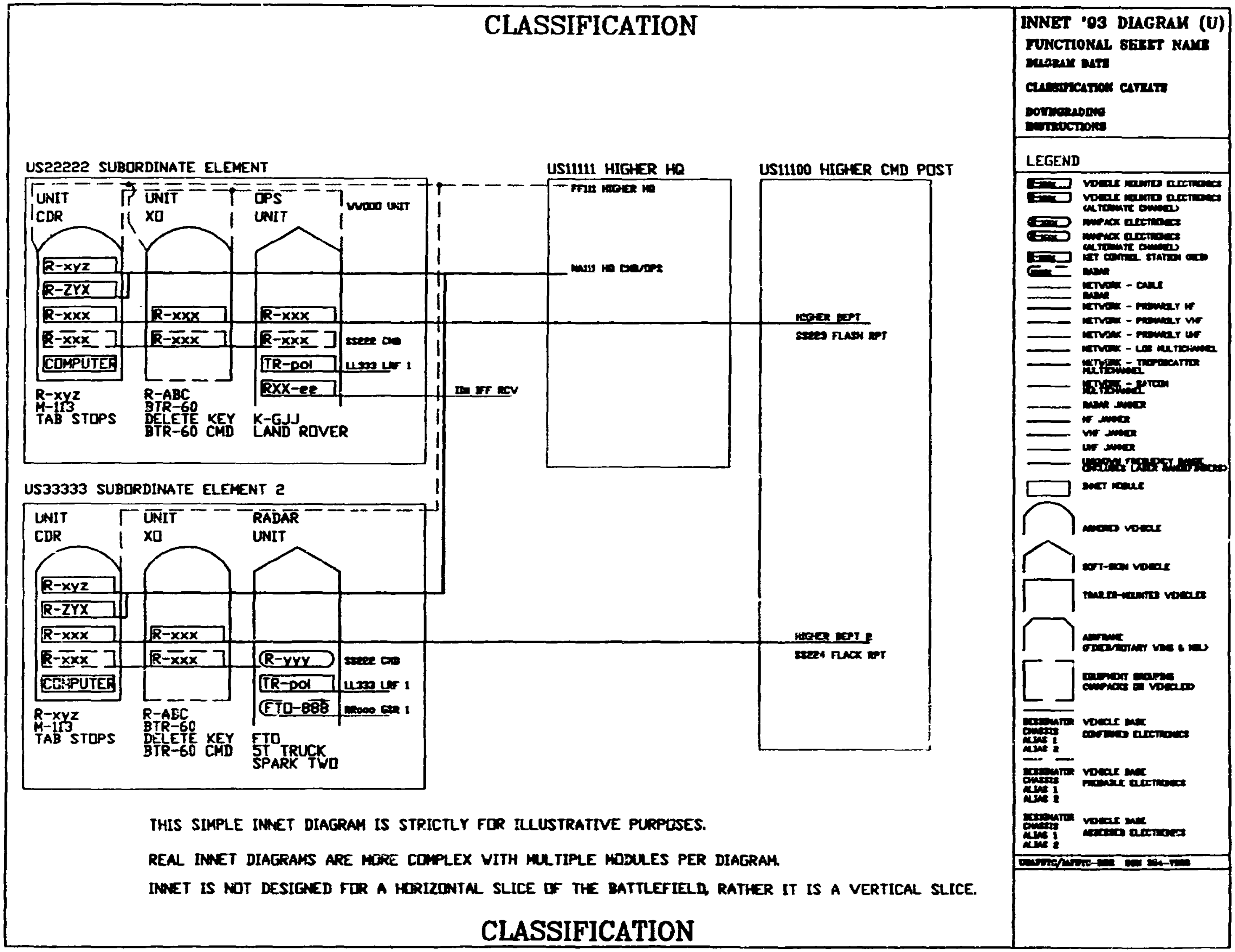


Figure 4. Sample of INNET Diagram

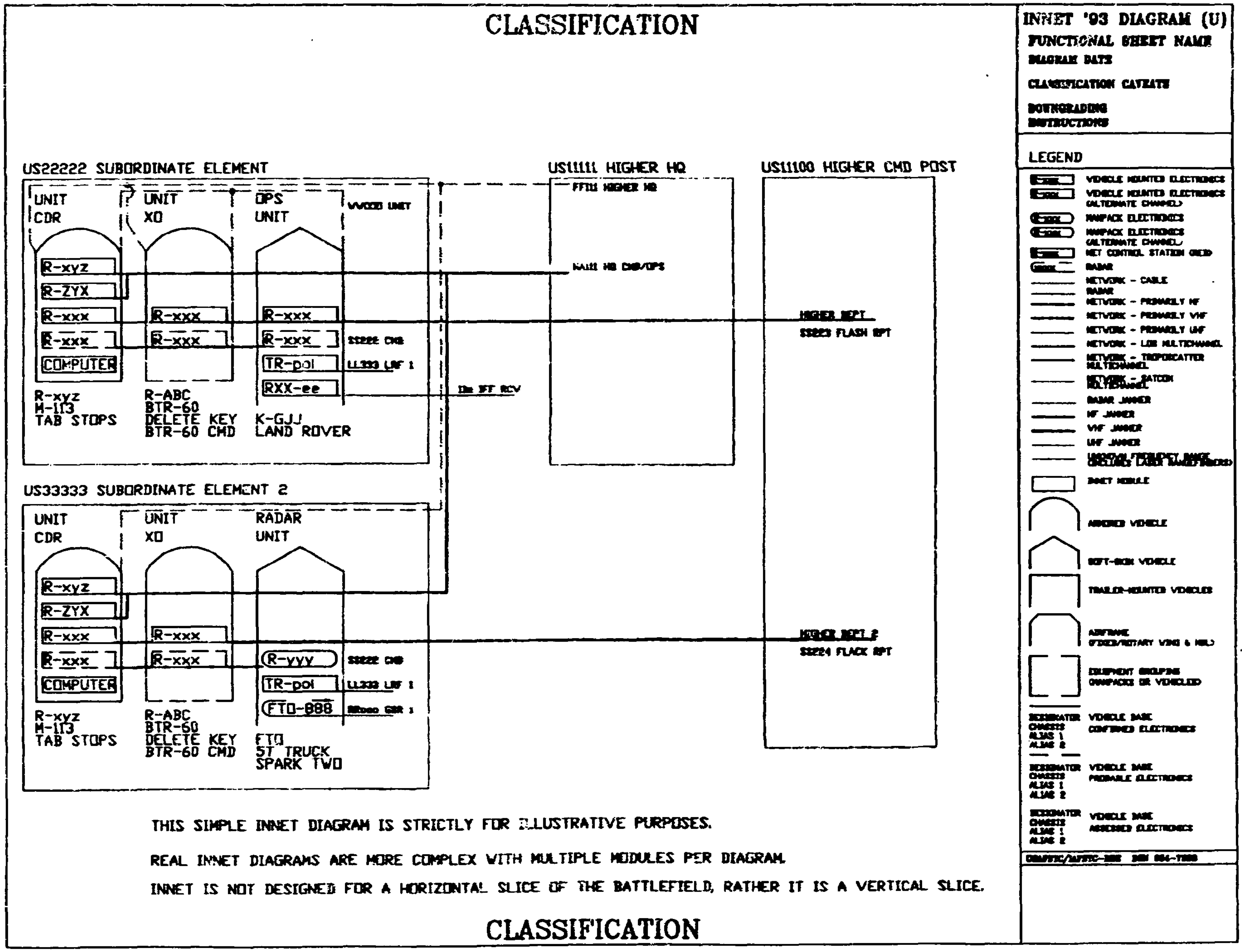


Figure 4. Sample of INNET Diagram

NGIC

COMPLEXITY SUMMARY

Number of system types

Interrelationships of system types

Complexity of systems

Meta data (baggage)

Multimedia requirement

APPENDIX C: DATA STANDARDS TASK FORCE MEETING BRIEFING CHARTS

"DIS Need for DoD Data Standards Paper"

Industry ⟷ Data Standards ⟷ DoD

Presented to the Data Standards Working Group
14 July 1994
by
MAJ Walter L. Swindell, II

USA TRAC
ATTN: ATRC-FSD

"DIS Need for DoD Data Standards"

Purpose of the paper:

To convince the DIS community that the DIS PDUs will not be adequate, efficient or cost effective for supporting interoperability among models and simulations, instead data standards based on the DoD data modeling and standardization process are necessary.

DIS PDUs not based on DoD Data Standards

Initial Meeting: 24 May at Resource Consultants, Inc.

Attendees:

Keith Gardner, STRICOM

*Luci Haddad, RCI

*Iris Kameny, RAND

Scott Kinser, RCI

*MAJ Walt Swindell, TRAC

Results:
- Outline Developed
- Initial Draft Assignments

* DIS Data Standards Group Member

"DIS Need for DoD Data Standards"

Outline:

- DIS Vision, initial draft by Iris Kameny
- DIS Problems Addressed by Data Standards, initial draft by Luci Haddad
- Future Vision of DIS with Data Standards, initial draft by Iris Kameny
- Data Standardization Process using DIS Examples, initial draft by MAJ Walt Swindell
- Need for Roadmap

"DIS Need for DoD Data Standards"

DIS Vision:

- Address handling of data within the DIS vision
- Problem/Inadequacy of vision
- What data standardization is

"DIS Need for DoD Data Standards"

DIS Problems Addressed by Data Standards:

- Efficiency/Cost Problems
- Credibility Problems
- Reuse of Models
- Interoperability (M&S Data Models and Stds vs. Operational)
- Lack of Industry/International Data Standards
- Data Standards Effects on Instance Databases
- Process Models in Operational Arena

"DIS Need for DoD Data Standards"

Future Vision of DIS with Data Standards:

- Data Standards in Messages and Protocols
- Information Resource Repository (IRR) System
- Interoperability between the M&S community and Real Operational Components

"DIS Need for DoD Data Standards"

Data Standardization Process using DIS Examples:

- Process Modeling
- Data Modeling
- Data Standards
- Domain Standards
- Nomenclature & Symbology Standards

"DIS Need for DoD Data Standards"

Need for Roadmap:

- Working with Operational World
- Applying Process and Data Modeling to DIS Concept of Operations

"DIS Need for DoD Data Standards"

Future Tasks for Group:

- Work on Roadmap Section
- Join Sections & Produce Final Paper
- Submit to 11th DIS Workshop by 1 August 1994
- Present Paper at Workshop: 26-30 September 1994

Concept Brief

M&S Distributed

Information Resource Repository (IRR) System

Iris Kameny

July 1994

RAND

Concept Brief
M&S Distributed Information Resource Repository (IRR) System

M&S community has data needs to achieve interoperability of M&S and reuse of data and M&S that can be met by:

- Directories to information resources (e.g., databases, M&S, authoritative data sources)
- Data standards based on data model and metadata descriptions including complex data standards
- Data verification, validation, and certification to define: data quality (e.g., completeness, resolution, accuracy, etc.), correctness, adherence to real world
- Rapid access, acquisition and processing of data in four phases of M&S: preparing inputs, executing M&S, post-processing, planning and executing exercises and experiments

Information Resource Repository

- Based on: minimal standards and conventions, common environment and toolset
  - Compliant with DoD TAFIM and commercial standards (e.g., Information Resource Management System (IRMS), Information Resource Dictionary System (IRDS), Portable Common Tools Environment (PCTE))
- Logically contains all of an M&S organization's information resources such as:
  - Data/information/knowledge bases
  - Software (e.g., models and simulations, standard algorithms)
  - Information standards (e.g., process and data models, data standards including nomenclature, icon and symbology standards)
  - Directories/catalogs of information resources (e.g., databases, models and simulations, authoritative data sources, DIS exercises, M&S organizations)
  - Common tools to engineer, manage, and manipulate the information resources
  - Common exchange interfaces to access information and exchange information resources among distributed IRRs
  - Application specific tools that may be private and not shared
- Long range: seamless access and exchange with standards based IRRs throughout DII and NII

A vision of use of the M&S Distributed IRR System

1. User requests M&S Information based on study needs to root M&S Directory using taxonomy
2. Return list of qualifying models and simulations to user
3. User uses M&S list to browse directory further to make selection and then to find relevant databases and data sources for selected M&S
4. User links to database directory and searches for more information on the appropriate databases as to quality, validity, currency, etc. and may contact authoritative sources for more guidance
5. When interesting databases are found, user can browse details by looking at the data model to see what entities/elements/and relationships are supported to decide their relevance to the study needs
6. From the data model, the user can link into the data dictionary of standards to look at specific data element definition (e.g., probability hit/kill) to be sure the concept is valid for the study
7. When user is satisfied with choices, he/she can electronically contact authoritative data sources and release authorities to negotiate transfer of model and databases to IRR of choice (relevant tools may also be requested)
8. Requests may be carried out by electronic transfer or offline transfer for execution at selected IRR (could be "home" IRR server or remote invocation, etc.)

Objectives in Reaching a Distributed IRR Capability

- Data standards to promote interoperability
- Directories/catalogs of databases, models and simulations to promote reuse
- Identification of authoritative data sources and their responsibilities to reduce data inconsistencies and make data more available
- Institutionalization of a data VV&C process to promote use of certified databases with clearly stated quality descriptors to be used in the M&S VV&A process to provide credible M&S results
- Multilevel security (MLS) to support MLS distributed IRRs and models and simulations

Master Plan for Data Area of M&S Infrastructure

Critical Areas:

- Policy, procedures, and standards: DASP, reverse engineering, education, storage of data standards, DIS data standards
- Information Resource Repository: CONOPS/design, prototype, operational system, initial distributed , distributed
- Complex data: categorization, pilot studies, standards and guidelines
- Directories: design, taxonomies, prototype, operational implementation
- Authoritative data sources: taxonomy, identification, directory, responsibilities, guidelines
- Data VV&C: definitions, quality profile, pilot studies, tools, guidelines
- Databases: move toward data centers, reverse engineering, migrate legacy databases into standards-based databases
- Security: repository and directories unclassified ⟶ system high ⟶ MLS, address data aggregation

7/14 Repository 1.1

M&S Repository Facility

Mitre's Task

Mike Gorman

July 14, 1994

MITRE

M&S Repository Facility

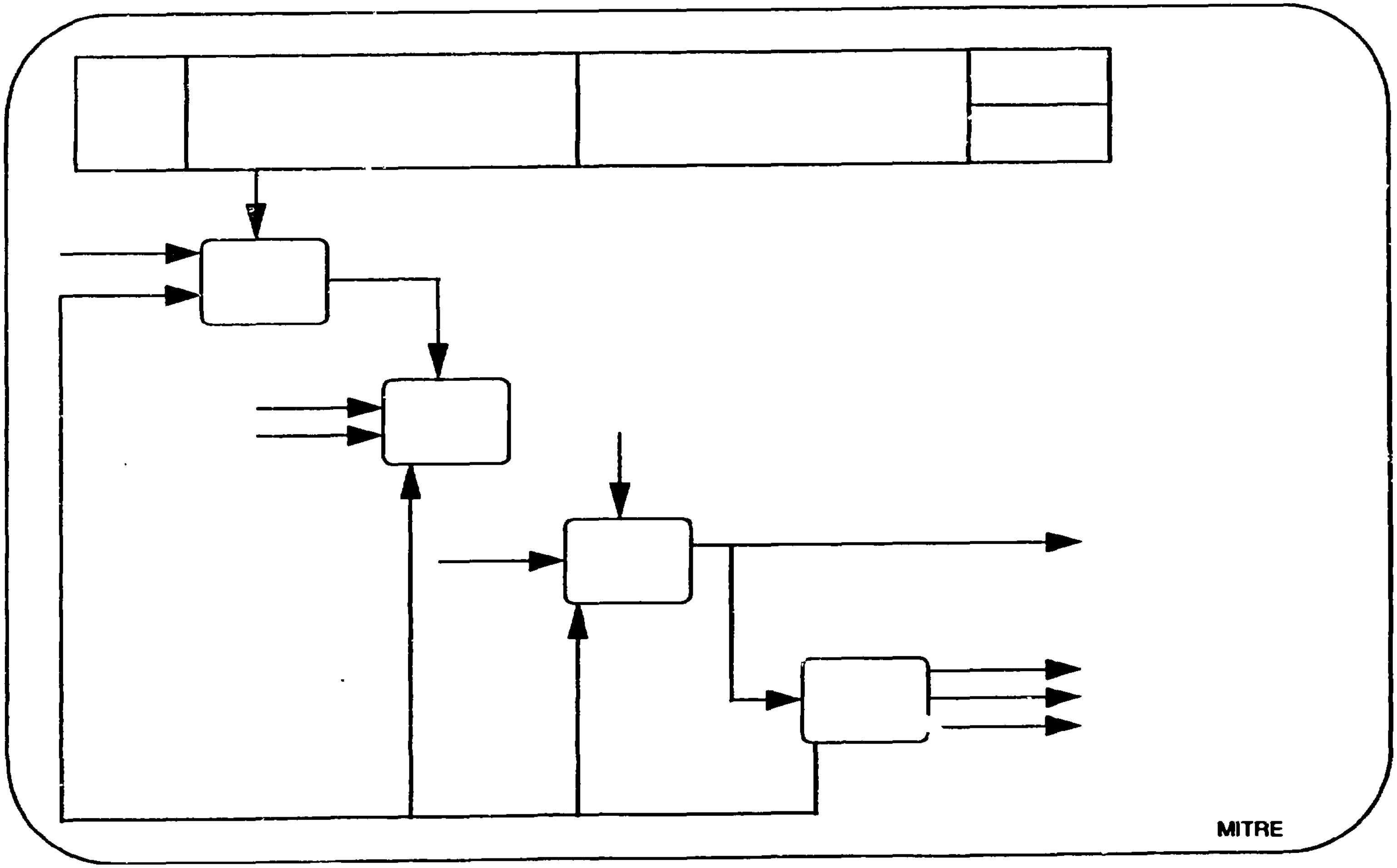
Modeling and Simulation

- Meta Products
  - IDEF-0 (Activity Diagrams)
  - IDEF-1X (Data Model Diagrams)
  - DFD (Process Digrams)
  - State Transition Diagrams
  - etc.
- Computer Code
- Actual Data

MITRE

M&S Repository Facility

IDEF-0 Diagram: Activity Model



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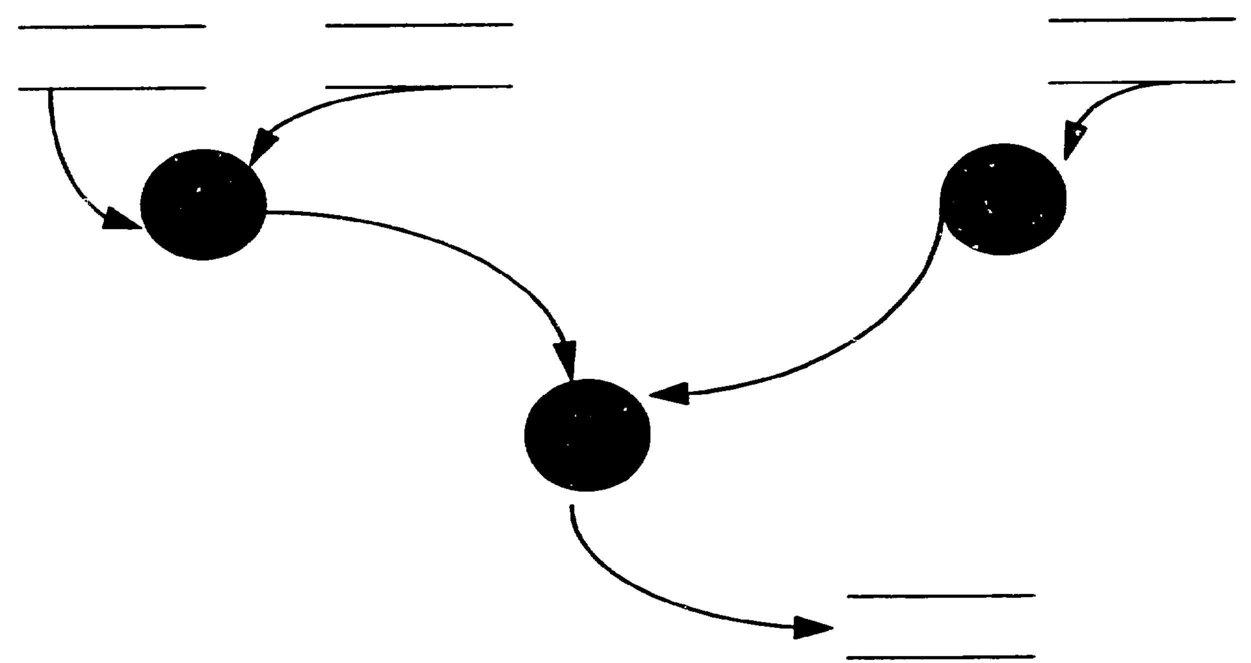
Data Flow Diagram: Process Model



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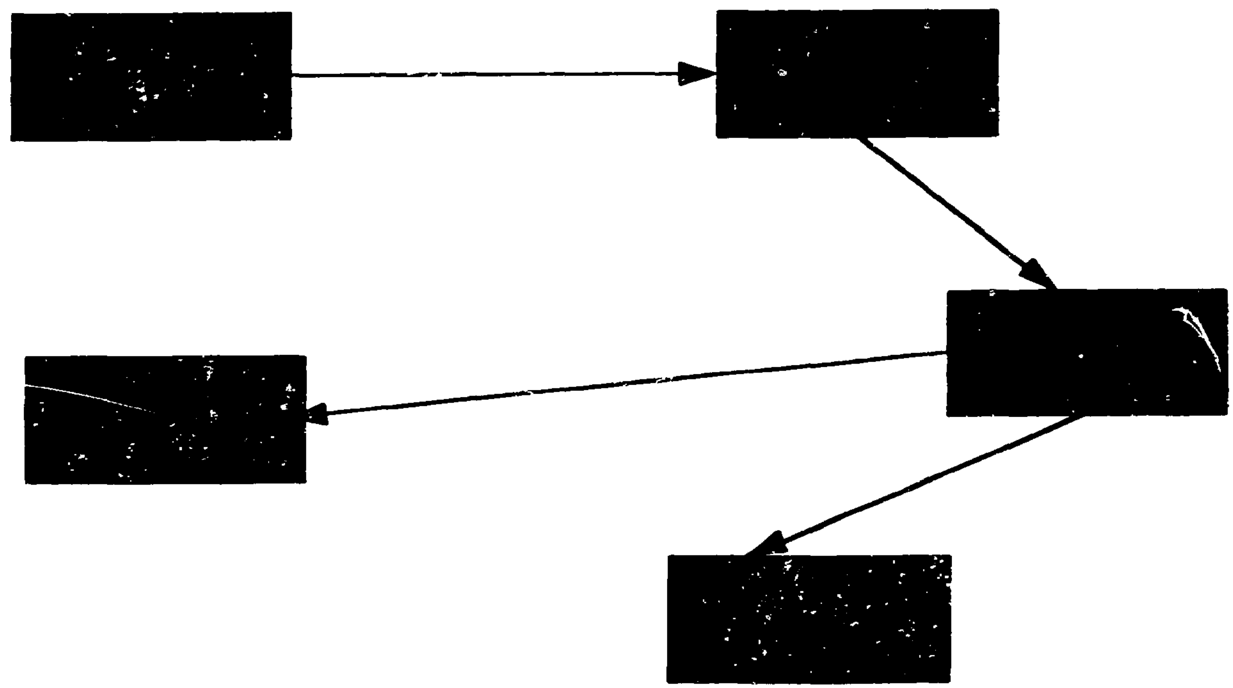
IDEF-1X Diagram: Data Model



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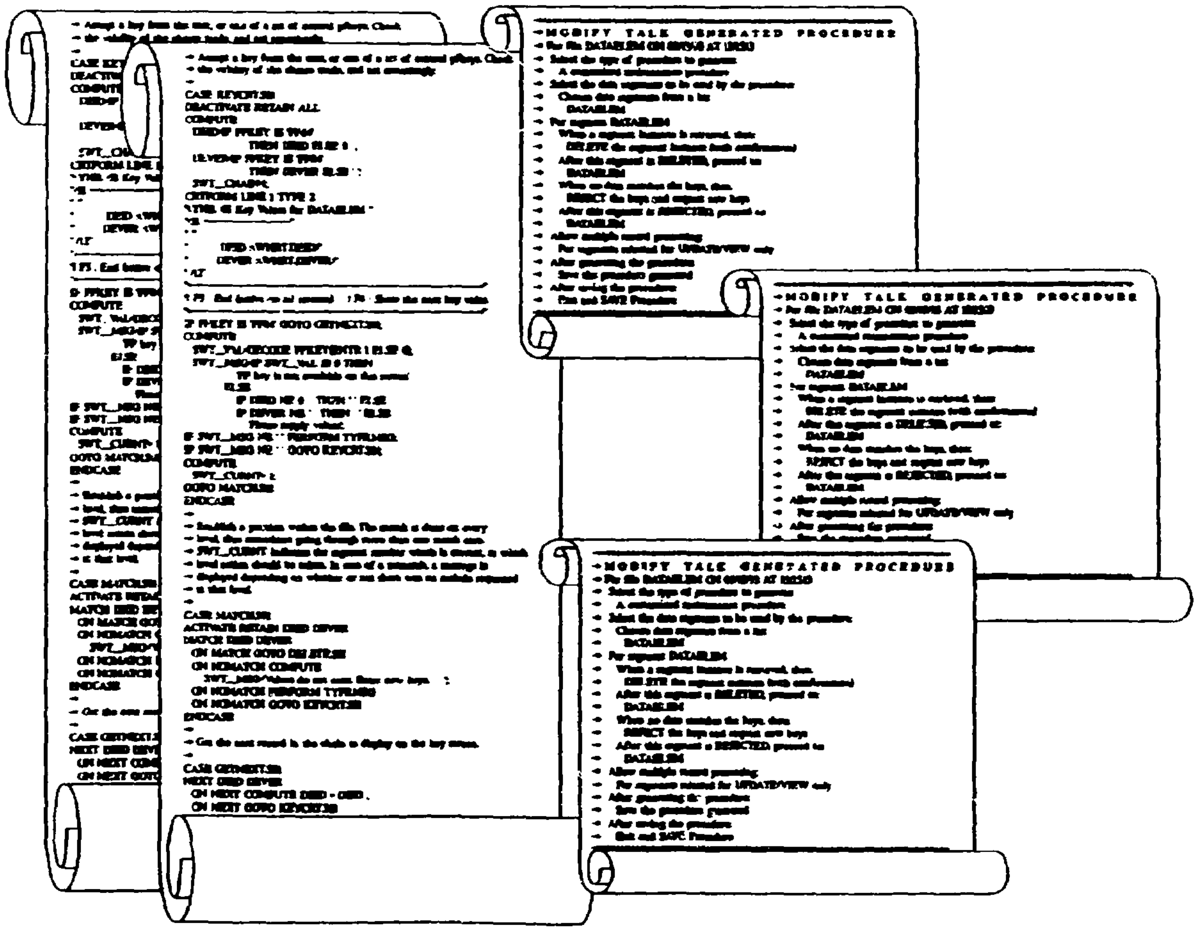
Model Computer Code



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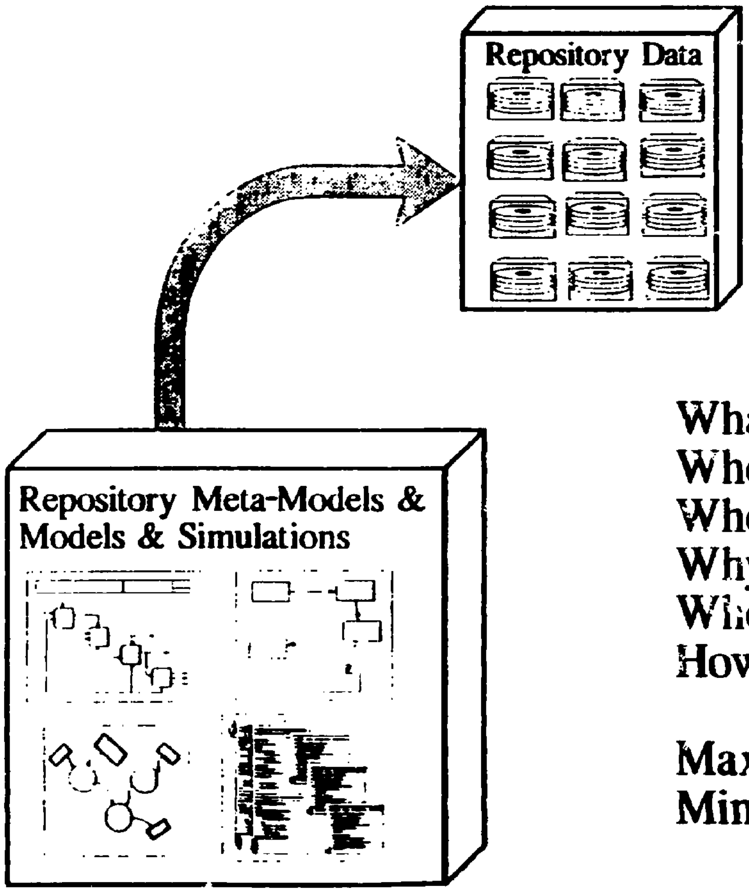
DMSO M&S Repository Components

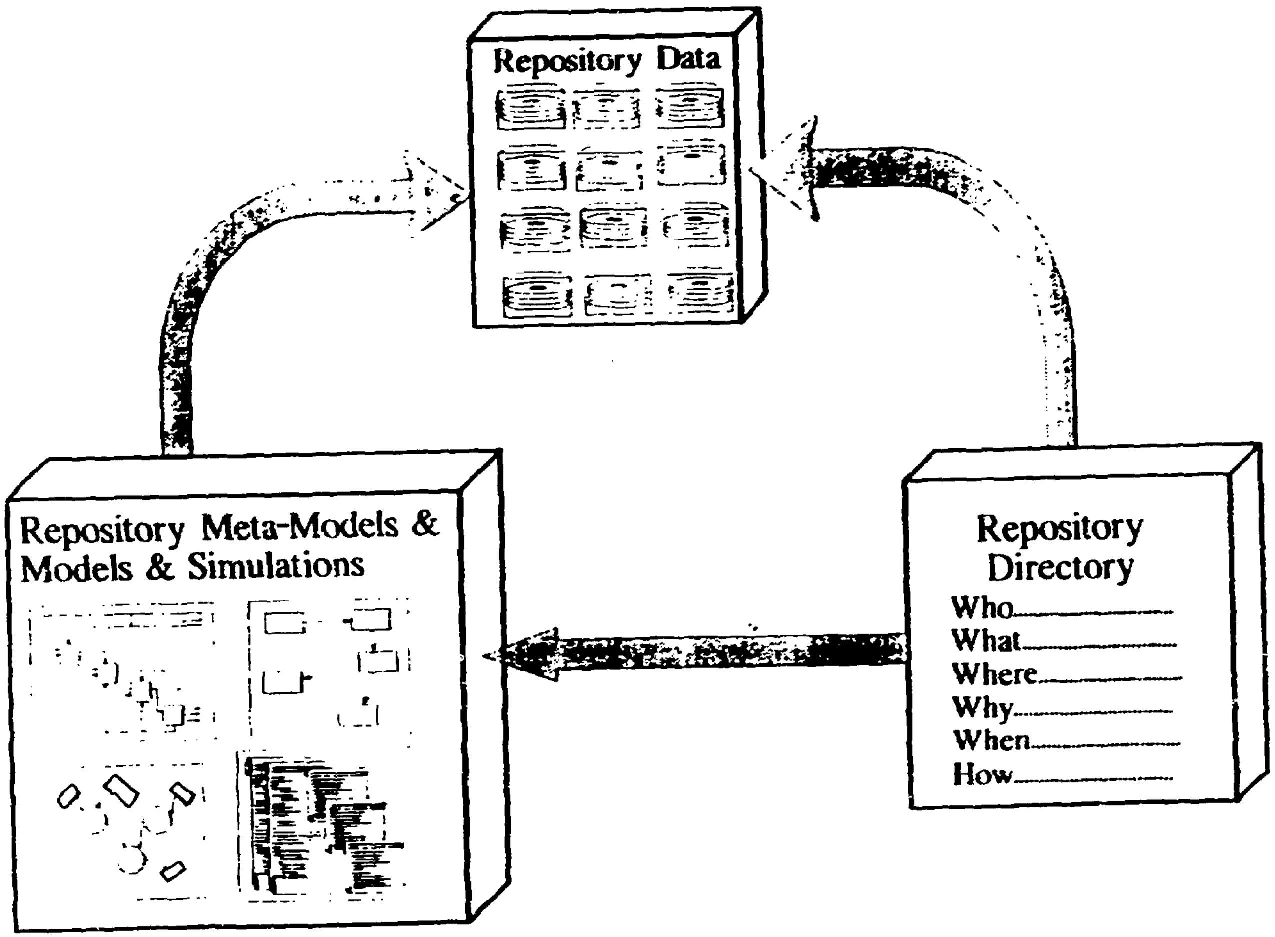


What ????
When ????
Where ????
Why ????
Who ????
How ????

Maximum Redundancy
Minimum Sharing

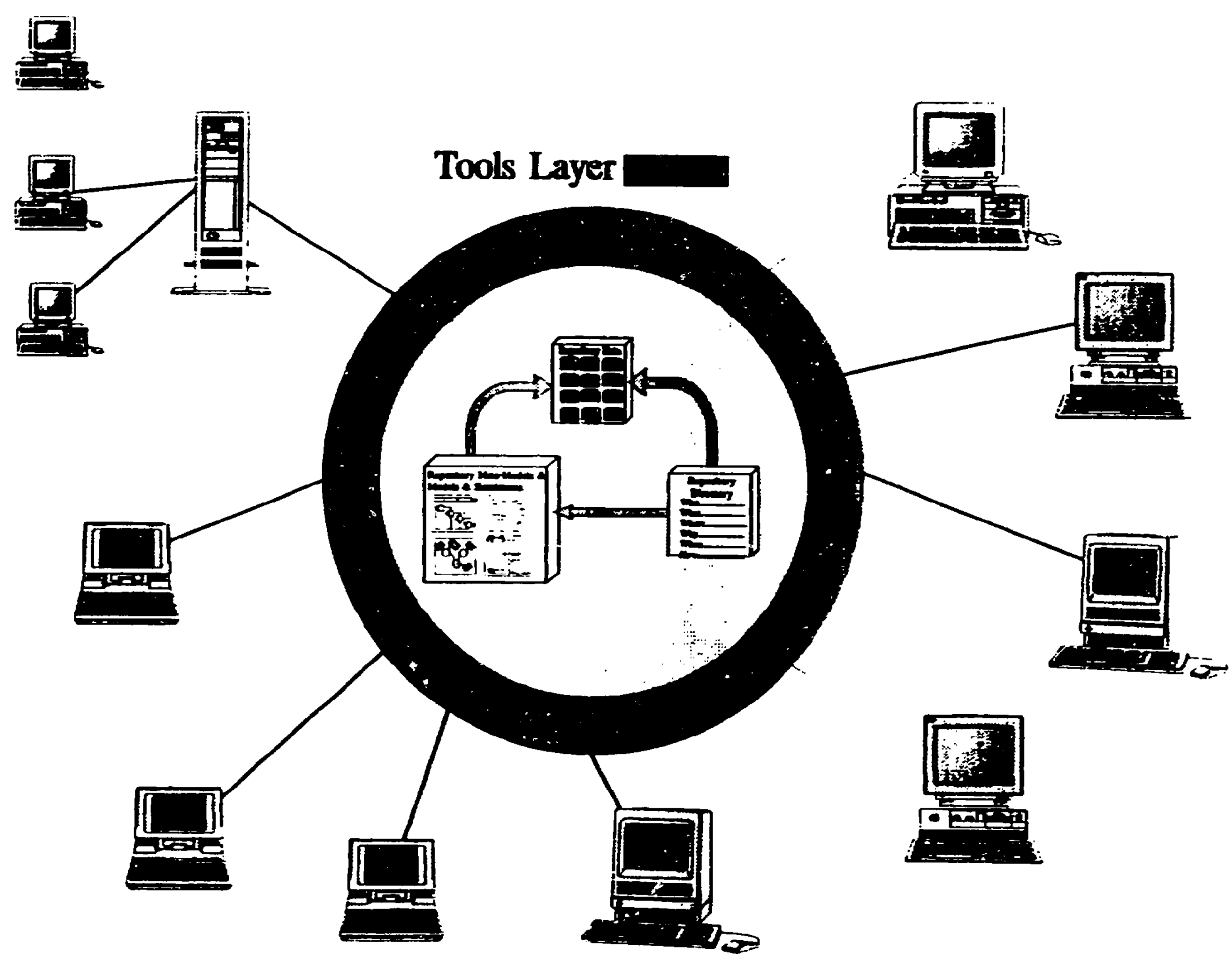
M&S Repository Facility

DMSO M&S Repository Components



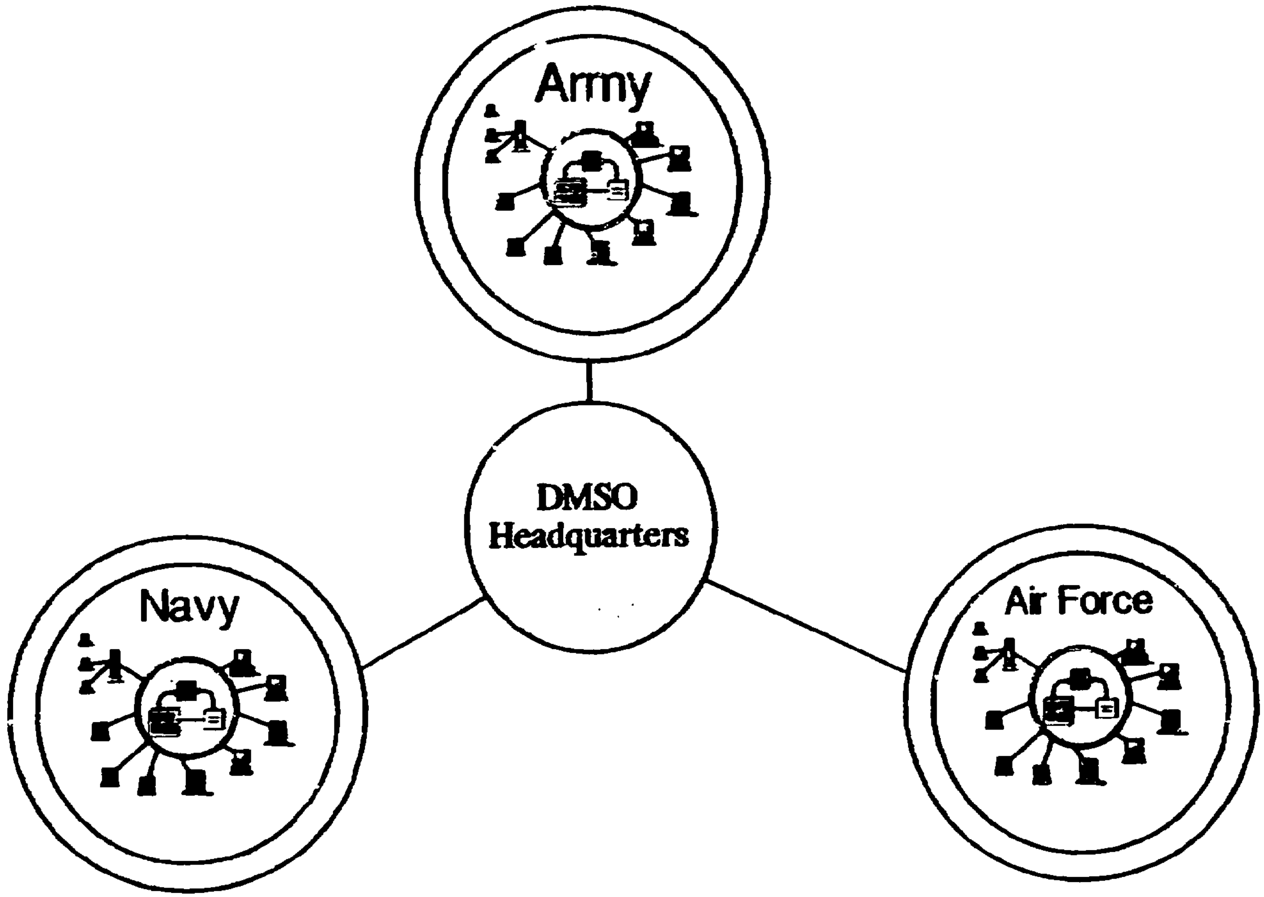
M&S Repository Facility

DMSO M&S Repository Facility



M&S Repository Facility

M&S Repository Community Network



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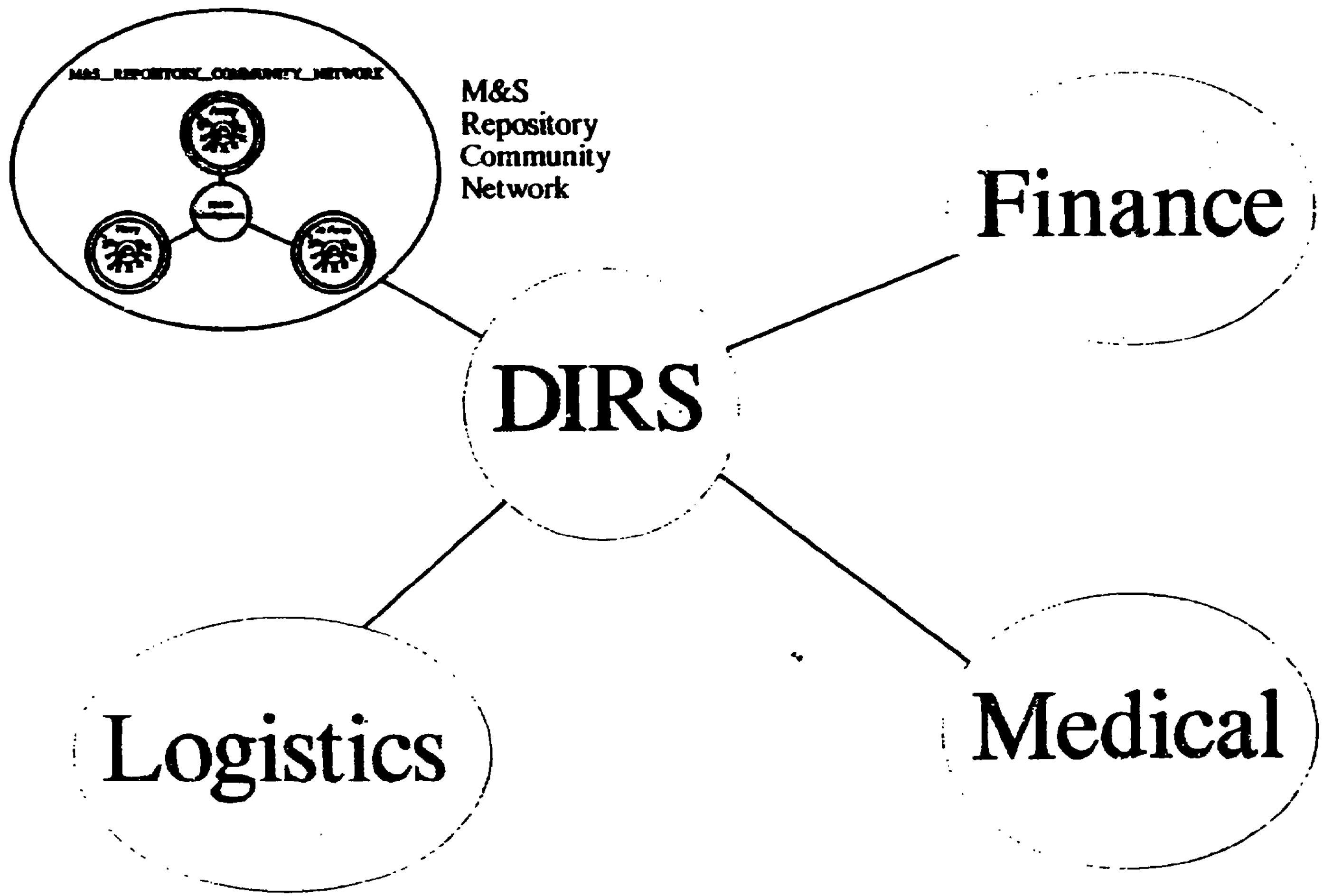
DIRS Network



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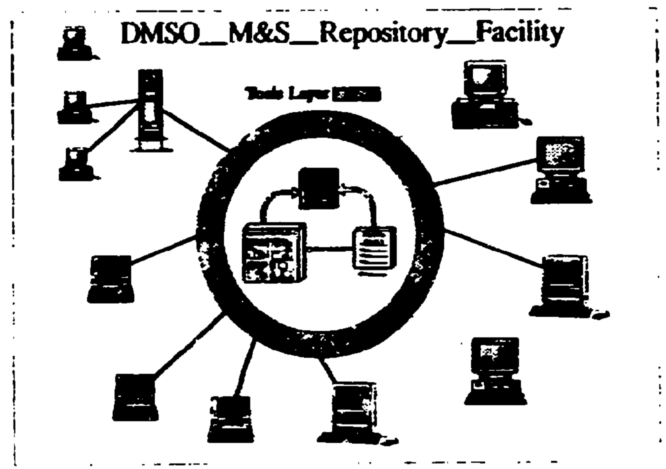
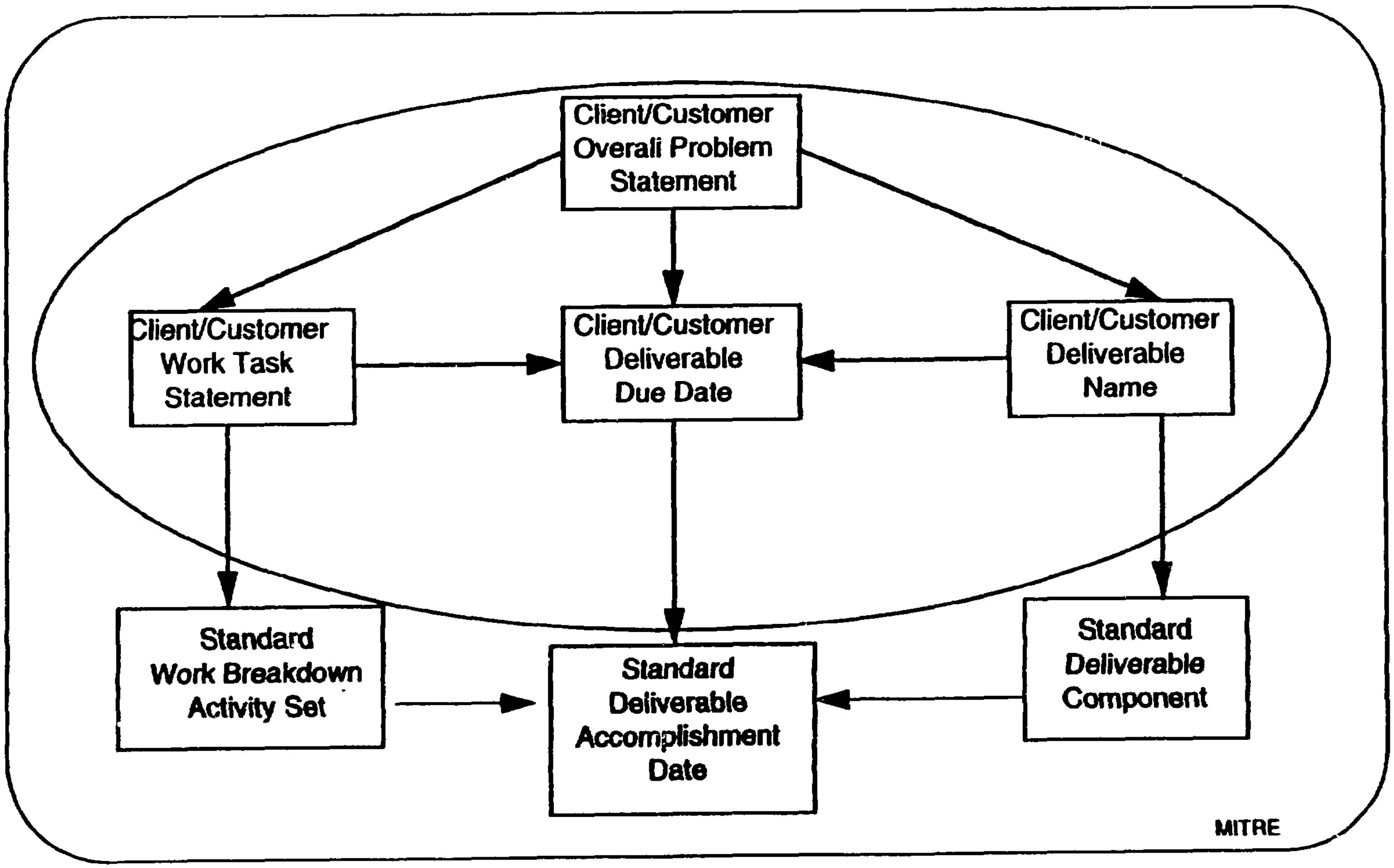
Mitre's Task



* Modeling & Simulation Mission Statement
* Repository Facility Data Model (IDEF-1x)
* Repository Facility Requirements (e.g., TAFIM, SQL, RDA, etc)
* Repository Facility Concept of Operations
  (Use roles defined through IDEF-0)

M&S Repository Facility



M&S Repository Facility

Overall Strtategy

- Get "inside" modeling and simulation community to learn about:
  - Missions
  - activities
  - products
- Build IDEF-1X and IDEF-0 diagrams for product and role requirements
- Identify extant standards, required standards, and issues dealing with M&S IDEF-1X & IDEF-0 products and activities

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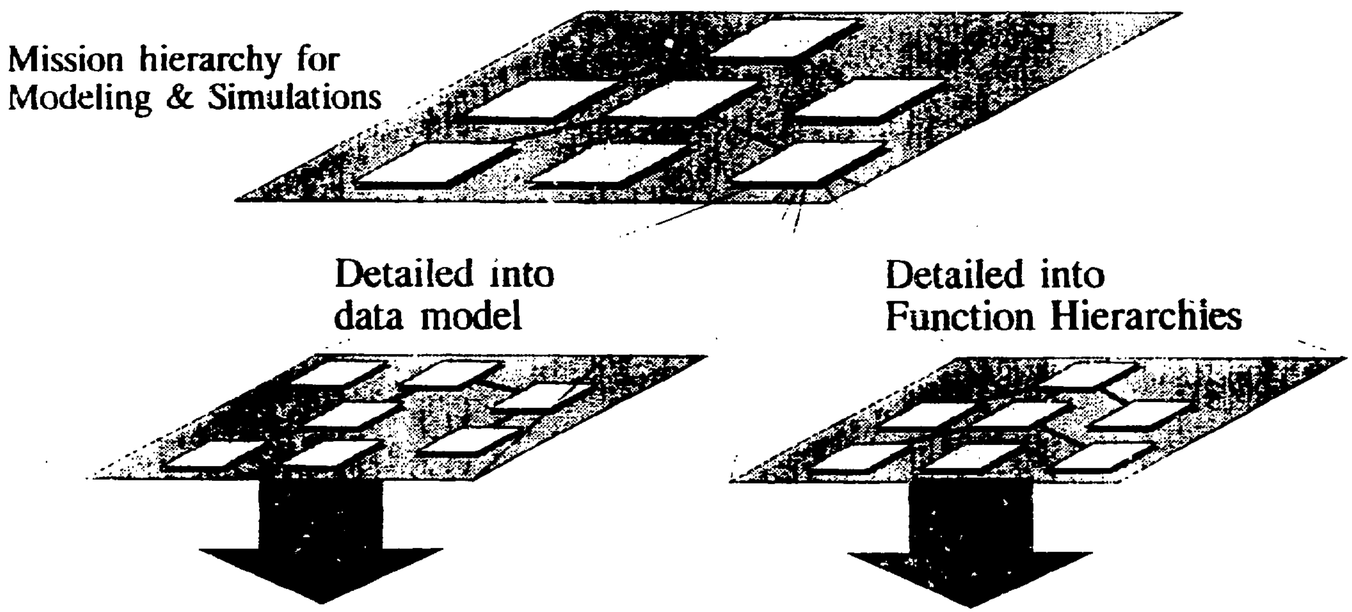
M&S Repository Facility

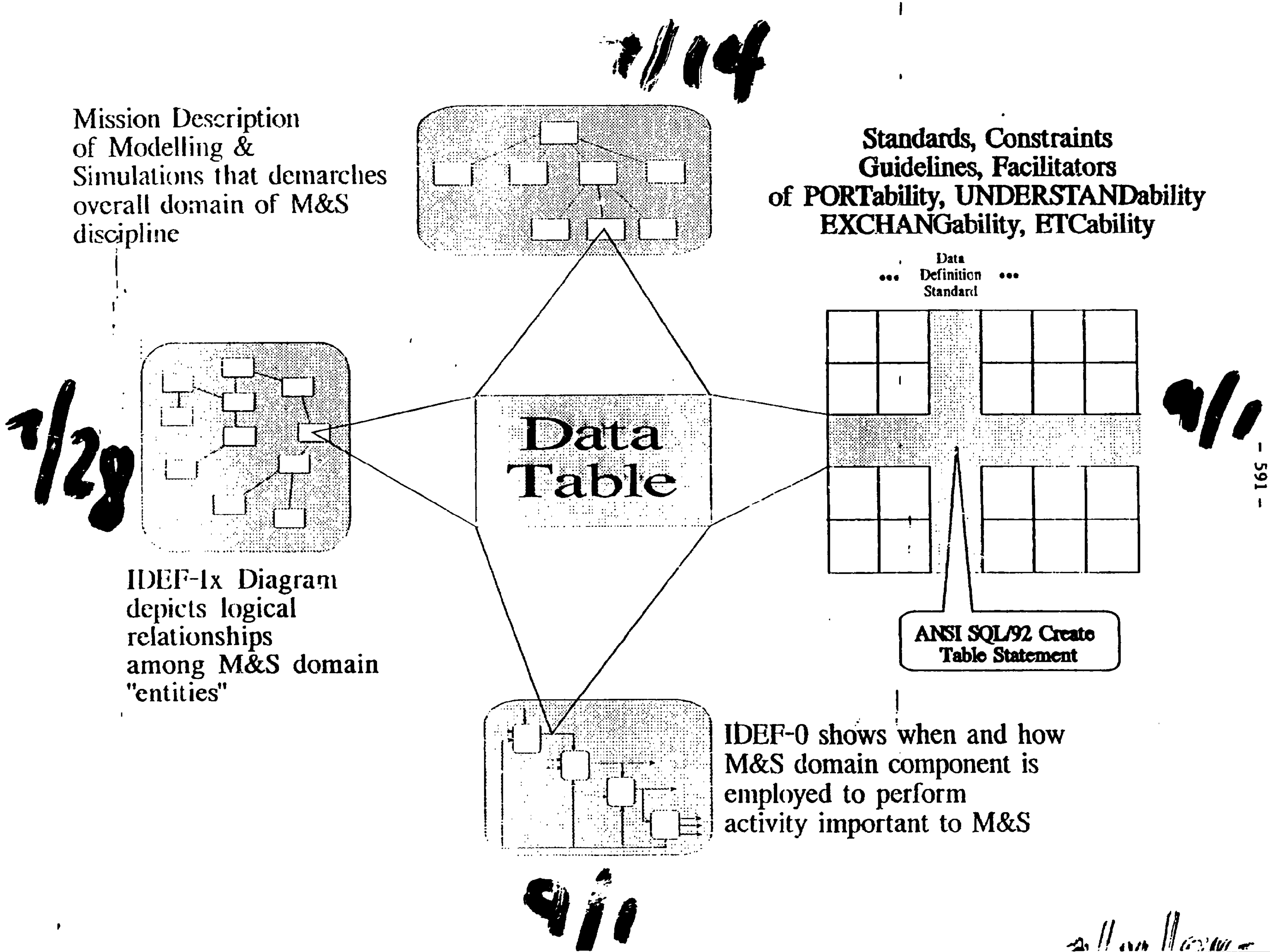
Task Deliverables Work Flow



IDEF-1X Diagram
of M&S Products

Standards, Impacts &
Issues re Products

IDEF-0 Diagrams
of M&S Roles
(e.g., FDaD, Study director,
etc.)


7/14
Mission Description
of Modelling &
Simulations that demarches
overall domain of M&S
discipline
Standards, Constraints
Guidelines, Facilitators
of PORTability, UNDERSTANDability
EXCHANGability, ETCability
••• Data Definition Standard •••
7/28
Data
Table
9/1
IDEF-1x Diagram
depicts logical
relationships
among M&S domain
"entities"
ANSI SQL/92 Create
Table Statement
IDEF-0 shows when and how
M&S domain component is
employed to perform
activity important to M&S
9/1

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MODELING AND SIMULATION FOR DOD MODELING APPLICATIONS IN SUPPORT OF THE WARFIGHTER

MISSION DESCRIPTION

I. BACKGROUND AND INTRODUCTION

Modeling and Simulation provide a way to analyze very complex processes that consist of many interacting components [1]. Models and simulations provide an integrated basis for analysis and decision making [1]. Models and simulations also provides a way to extrapolate existing processes and workloads to new situations [1]. Generally, Modeling and Simulations realistically portray complex operations and interactions that allow the users to:

1. Clarify thinking
2. Select an alternative(s)
3. Make decisions
4. Test hypotheses
5. Plan
6. Train others

Modeling and Simulation generally falls into one of two classes:

1. Exploratory
2. Consolidated

Exploratory models are generally used to better understand the hypotheses or theory regarding some system when there are not hard facts known about the situation being modeled. Modelers must make guesses about the facts regarding the modeled situation. The executing model then behaves as if the guesses made about it were correct.

Consolidated models, in contrast to exploratory models, model situations in which there is a very high level of confidence about the facts. These facts are commonly consolidated into automated packages, e.g a COTS spreadsheet, which is then used as a surrogate for the situation being modeled. These models behave very much like the real situation and for that reason may be used to predict system behavior.

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Models vary in size from small spreadsheets to very large simulations that require multiple computer resources existing in different geographic locales with several hundred people involved and several months to produce output.

The material below presumes a working knowledge of Enterprise Database models and techniques as contained in the text Enterprise Database in a Client/Server Environment. The model described below is the mission model (Chapter 5).

Section II below contains the top level of the models and simulations mission description. This description is intended to define the outside boundaries of all the missions appropriate for the successful and quality accomplishment of models and simulations. NOT stated or even to be inferred is how these missions are accomplished, nor who accomplishes them. These are not stated because missions are independent from organization and procedure.

After the top level of the mission is "agreed to" creation of two or more lower levels will begin. At the end of the effort (probably two weeks) from the date of this document, the set of all models and simulations missions will be complete. Thereafter, each lowest level node on the hierarchies will be examined to determine the data domain associated with that node.
An entity relationship diagram will be created for each node. All ERDs will be semantically merged to ensure entity non redundancy. That ERD will then be declared the data-requirements-scope for the Modeling and Simulation repository. It will have to be reviewed and when (not if) changed, adjustments to this mission statement must take place.

Once the ERD is reviewed and approved, it will be fully attributed and transformed into third normal form. The business primary keys will be identified, and the referential integrity & actions determined. Upon review and acceptance that will complete the activities associated with determining the metadata requirements of the Modeling and Simulation Repository.

The material below describes the **mission** of Modeling and Simulation. These mission statements should not be viewed as identifying required agencies/sub-agencies within a Modeling and Simulation environment/community. In addition, not all the submissions identified below are required for each and every Model and Simulation. For example, Model Dispersion and Support is a sub-mission of the overall Modeling and Simulation mission. Some models may not be dispersed nor supported; thus, the components of this sub-mission are not necessary to successfully support the overall mission. Many times models are constructed and

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not documented since documentation can double the cost of developing a model. The point is that not every model requires all the mission components.

II. HIGH LEVEL--MODELS AND SIMULATIONS MISSION DESCRIPTION

The successful accomplishment of models and simulations requires: model development; project management; validation, verification and certification; data collection, model dispersion and support, model operation, and scenario generation.

1. Model development results in the development of requirements, designs, implementations, tests, and maintenance of the model

2. Project Management includes pla.˘s, organization, direction, controls, monitoring, and staff to insure that Models and Simulations are developed on time, on budget, and meet requirements.

3. Validation, Verification, and Certification ensures that the model is a correct representation of the situation, that it generates correct repeatable output, and that some agency formally declares the model suitable for specified usage in a specified manner.

4. Data Collection provides model developers with information used to construct a model that fairly represents the situation. This data provides insight into the range or intervals where use of the model is indicated, support for scenario generation, support for requirements definition, and level of model aggregation. Data collection is also required to provide input for model operation. This data may be contained in a data dictionary or Data Base and can be discovered by surveying the literature, browsing repositories, interviews, and empirical data acquisition.

5. Model Dispersion and Support refers to training (plans, manuals, procedures), support groups, data sharing, and shipping that facilitate a wide range of model use.

6. Model Operation refers to activities required to manage an executing model. Controllers are required to make certain that all model

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components are synchronized, monitors collect output, coordinators ensure that all needs are being serviced, model operators or participants are required to make the model react.

7. Scenario Generation refers to scripting model runs. A scenario specifies the operational environment, e.g. in a flight simulator , whether the landings are during the day or night, if the landings are aboard ship or on land etc.. A scenario also specifies the system configurations, i.e. the values the various factors that the model needs to produce output (input parameters , structural assumptions) may assume. Scenario generations are the result of an "Experiment Design Plan".

8. Output/Analysis focuses on the model output. For consolidated models the output is the answer and no analysis is required. For exploratory models the output is analyzed to ascertain model accuracy, refine the model, test hypotheses etc..

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III. DETAILED--MODELS AND SIMULATIONS MISSION DESCRIPTION

1.0 MODEL DEVELOPMENT

Model development ensures that the execution of the implemented model will support the Modeling and Simulation mission. To fulfill the *Model development* mission, the model requirements are developed (analyzed and defined); the architecture (high level organization/design of the software) is developed; the model is coded to specification or implemented; the model is tested to make certain that it performs as intended. Model deficits are corrected and the model is retested; the model goes into the maintenance phase where additional corrections are made and/or new features are added.

1.1 REQUIREMENTS ANALYSIS

Requirements analysis involves four basic steps: (1) Problem recognition (2) Evaluation and synthesis (3) Specification (4) Review. [4]

1.1.1 Problem recognition

Problem recognition creates a careful formulation of the problem statement, defines the issues to be investigated, understands the measures of performance for evaluation (by the model), grasps the manner in which the model will be used, conceives alternative system configurations of interest to be represented by the model, and determines model aggregation (level of model detail) by using experts and sensitivity analysis. The customer/user must supply input to foster this analysis.

1.1.2 Evaluation and Synthesis

Evaluation and synthesis understands the flow and structure of the information involved, defines and refines software functions, establishes system interface characteristics, and discovers design constraints.

1.1.3 Specification

Specification results in a design specification (e.g. an SRS or prototype) that specifies what is to be constructed and validation criteria (the requirements themselves) used to test against to make certain that the correct model is constructed (if the criteria are met then the model is valid).

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1.1.4 Review

Review secures approval from all interested parties, e.g. the customer/user, system engineers, etc., as to the correctness and appropriateness (this is one of the ways that validation and verification are accomplished) of the deliverables.

1.2 DESIGN

Design translates requirements into a representation of the software. The design focuses on three areas: data, software architecture, and procedure.

1.2.1 Data Design

Data design identifies individual data elements, understands the relationship among them, designs efficient data structures that house them for access, and depicts the flow of data. Data design includes data modeling using ERDs, identifying data objects, depicting the data flow using DFDs, building data dictionaries, and using various data structures (array's, linked lists, DB, etc.) to store data elements.

1.2.2 Software Architectural Design

Software Architectural design assigns requirements to software components; decomposes each component into process modules and associated data structures, and defines the communication (interfaces) between the modules.

1.2.3 Procedural Design

Procedural design focuses on the processing details of each module individually. These processing details include data required to begin processing (input data), data that the processing generates (output data), sequence of events, exact decision points (control flow), repetitive operations, data organization/structure and any special algorithms. The specification of these design details are represented using a notation e.g. PDL.

1.3 CODING

Coding translates design specifications into an executable representations. A programmer makes this translation using programming tools (editors, compilers,

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assemblers). This entails producing and analyzing listings, exercising modules, and placing the completed modules under CM.

1.4 TESTING

Testing ensures that the software is an accurate reflection of the specification. The software is tested against the requirements from which the software was developed. Some testing is done by programmers. This is testing of the module in isolation and is called unit testing. Integration testing refers to grouping several modules that form a logical unit and testing them as a group. This testing is designed to ensure that groups interact properly. Integration testing is continued (more tested components are grouped) until the entire system is tested. To do this test plans, procedures, and test cases have to be generated. Test results are evaluated and defects are corrected. In many cases regression testing must be performed. The corrected tested modules must be placed under CM.

1.5 MAINTENANCE

Maintenance involves modifying the software in response to customer requests to fix problems or to add new features and requires doing all the things done in "Model Development".

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2.0 PROJECT MANAGEMENT

Project management develops and executes plans, creates organizations, designs the managerial and technical process, and develops the work elements, schedule, and budget to manage the model development which ensures the Modeling and Simulations mission.

2.1 PLANNING

Planning develops and adjusts the software project management plan.

2.2 PROJECT ORGANIZATION

Project Organization defines the process model, creates the organizational structure, identifies and defines the organizational boundaries and interfaces, develops strategies/policies, sets procedures and rules, defines responsibility and authority, hires, terminates, evaluates, trains personnel and sets project responsibilities.

2.3 MANAGERIAL PROCESS

Managerial Process identifies management objectives and priorities, identifies assumptions, dependencies, and constraints, manages risk, sets monitor and control mechanisms, and develops a staffing plan.

2.4 TECHNICAL PROCESS

Technical process identifies, selects, and correctly uses development processes, methods, tools, and techniques, writes software documentation, and facilitates project support functions.

2.6 WORK ELEMENTS, SCHEDULE, AND BUDGET MANAGEMENT

Work elements, schedule, and budget management identifies and assigns work packages, identifies dependencies, estimates resource requirements, develops a budget, and allocates resources, builds and adjusts schedules.

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3.0 VALIDATION, VERIFICATION, AND CERTIFICATION

Validation, verification, and certification supports Models and Simulations ensuring that the implemented model is an accurate representation and abstraction of the situation intended for study, that it was built correctly (implying that it will perform correctly), and that if used as intended is a credible tool.

Validation and Verification are a subset of SQA activities and is performed iteratively throughout model development. The model is certified after it has been accepted and used successfully (multiple times) by the customer. To ensure a valid conceptual model the requirements must be faithfully translated throughout model development. Verification happens as the requirements, design, software, and documentation are reviewed, inspected, and tested. Validation and Verification result from the correct application of methods and tools, conducting formal technical reviews, testing, and record keeping and reporting. Certification involves showing empirically that the tool performs as intended and a formal declaration by an agency stating the same.

3.1 APPLICATION OF METHODS AND TOOLS

Application of methods and tools monitors the use of the methods and tools used to construct the model.

3.2 CONDUCTING FORMAL TECHNICAL REVIEWS

Conducting formal technical reviews involves reviewing various work products including requirements, specs, plans, documentation, and designs.

3.3 TESTING

Testing is covered above

3.4 RECORD KEEPING AND REPORTING

Record keeping and reporting collects the results of reviews, audits, change control, testing, and other SQA activities and disseminates them on a need-to-know basis.

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3.5 EMPIRICAL DEMONSTRATIONS

Empirical Demonstration involves documenting the successful results of the model. In order to produce valid and useful Modeling and Simulation results, the data used in a model must be VV&C by the data producer and VV&C by the exercise or study director as part of the model or exercise VV&A process. The results and conditions of the demonstrations are used as the basis for issuing the formal certification.

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4.0 DATA COLLECTION

Data Collection helps to ensure the Modeling and Simulation mission by providing model developers with information used to construct a model that fairly represents the situation, input data for the model, and to provide insight into the application types where use of the model is indicated. It also provides support for scenario generation, support for requirements definition, and level of model aggregation. To ensure this, sub-mission data standards and recognized authoritative data sources are required to ensure data and algorithm consistency, especially for interoperating across models. In general Modeling and Simulation data collection focuses on locating, accessing, acquiring, and preparing data inputs. In support of this sub-mission users and/or developers may use data centers whose purpose is to collect, maintain, verify and validate, and provide data either to specific models or to users of models. In summary, the Modeling and Simulation community needs rapid access, acquisition and processing of quality, consistent, valid data for input to models and simulations. [5]

4.1 MODEL USE

Model use involves using all descriptive information about the model to understand if the model is appropriate given some arbitrary application and using correct, proper, and appropriate inputs with which to perturbate the model. This information includes, title, model category, keywords, proponent, developer, point of contact, statement of purpose, description, date implemented/updated, limitations, input, parameter range values, expected output, required hardware, software, available documentation, classification, model data verified and validated, data owner/authority, data standard employed, and general data about the model.

4.2 SCENARIO GENERATION

Scenario generation see scenario generation below

4.3 MODEL CONSTRUCTION

Model construction see requirements analysis above

4.4 MODEL AGGREGATION

Model aggregation refers to level of detail captured in the model about the situation being modeled. These activities are covered above in requirements definition.

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4.5 MODEL INPUT

Model input is covered above under *model use.*

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5.0 MODEL DISPERSION AND SUPPORT

Model dispersion and support include training (plans, manuals, procedures), user documentation, user support , (help line) data sharing (including executing the simulation and exchanging data interoperably with other simulations), and shipping to facilitate a wide range of model use. This sub-mission could be supported by an Information Resource Repository (IRR) which would logically contain all of an organization's information resources including tools for accessing, managing, maintaining and protecting its resources.

5.1 TRAINING

Training includes developing training plans and procedures, building training manuals and other user documentation, and setting training policies.

5.2 USER SUPPORT

User support ensures the mission success by being a major component of the support infrastructure. This infrastructure includes the help line and the IRR which will logically contain all of an organization's resources including tools for accessing, managing, maintaining and protecting its resources. The resources include entities such as: data/information/knowledge bases; software (e.g., models and simulations, algorithms); data and information standards (e.g., process and data models, data dictionaries); data standardization entities (e.g. metadata describing standard data entities, attributes, relationships, domains/nomenclature, and symbols) directories/catalogs of information resources, organizations, etc.; documents; common tools to engineer, manage and manipulate information resource entities; toolsets that could include capabilities for: directory accessing, browsing, linking, etc.; management and use of data standards; and application tools specialized to meet the organization's particular needs;management and use of data standards; management and verification of models and simulations; management and verification and validation of databases; management of algorithms; preprocessing and post processing of data; CASE tools for developing Modeling and Simulation software; etc. [5]

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6.0 MODEL OPERATION

Model operation refers to activities required to manage an executing model. Controllers are required to make certain that all model components are synchronized, monitors collect output, coordinators ensure that all needs are being serviced, model operators are required to make the model react. Model users may want to report their experience using models to the model owners.

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7.0 SCENARIO GENERATION

Scenario generation refers to scripting model runs. A scenario specifies the operational environment. A scenario also specifies the system configurations, i.e. the values the various factors the model needs to produce output (input parameters , structural assumptions), may assume. Scenario generations are the result of an "Experiment Design Plan" which provide management support for designing model runs and experiments. It also provides support for maintaining records of experiments.

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8.0 OUTPUT/ANALYSIS

Output/analysis is concerned with the post-processing of Modeling and Simulation results. The simulations provide us with hard answers when using a consolidated model. These models have been constructed with data that has a high probability of being correct at some level of detail. The output of these models can be considered valid enough to make decisions on or used to enforce/set policy. When using an exploratory model the model does not provide hard answers. Instead, these models provide additional insight e.g. existence proofs, hypothesis generation, or special cases. These models have been constructed without data where there is a high confidence level regarding its certainty.

By using data standards for variables within models and simulations, the data results for post-processing will be standardized and more easily handled by shareable tools.

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EOSDIS Information Management

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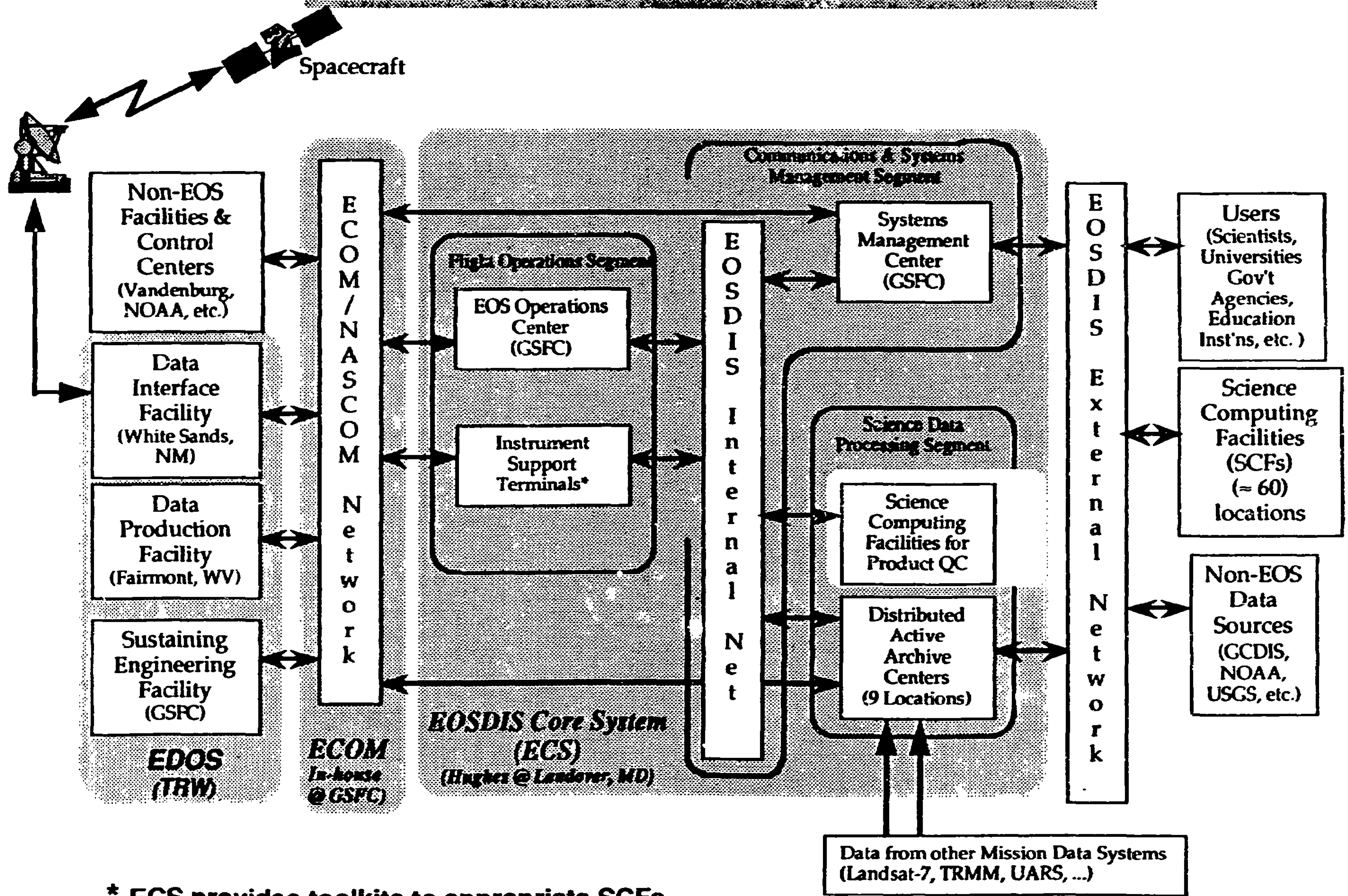
DMSO I/DB Task Group Meeting
July 14, 1994

EOSDIS Architecture



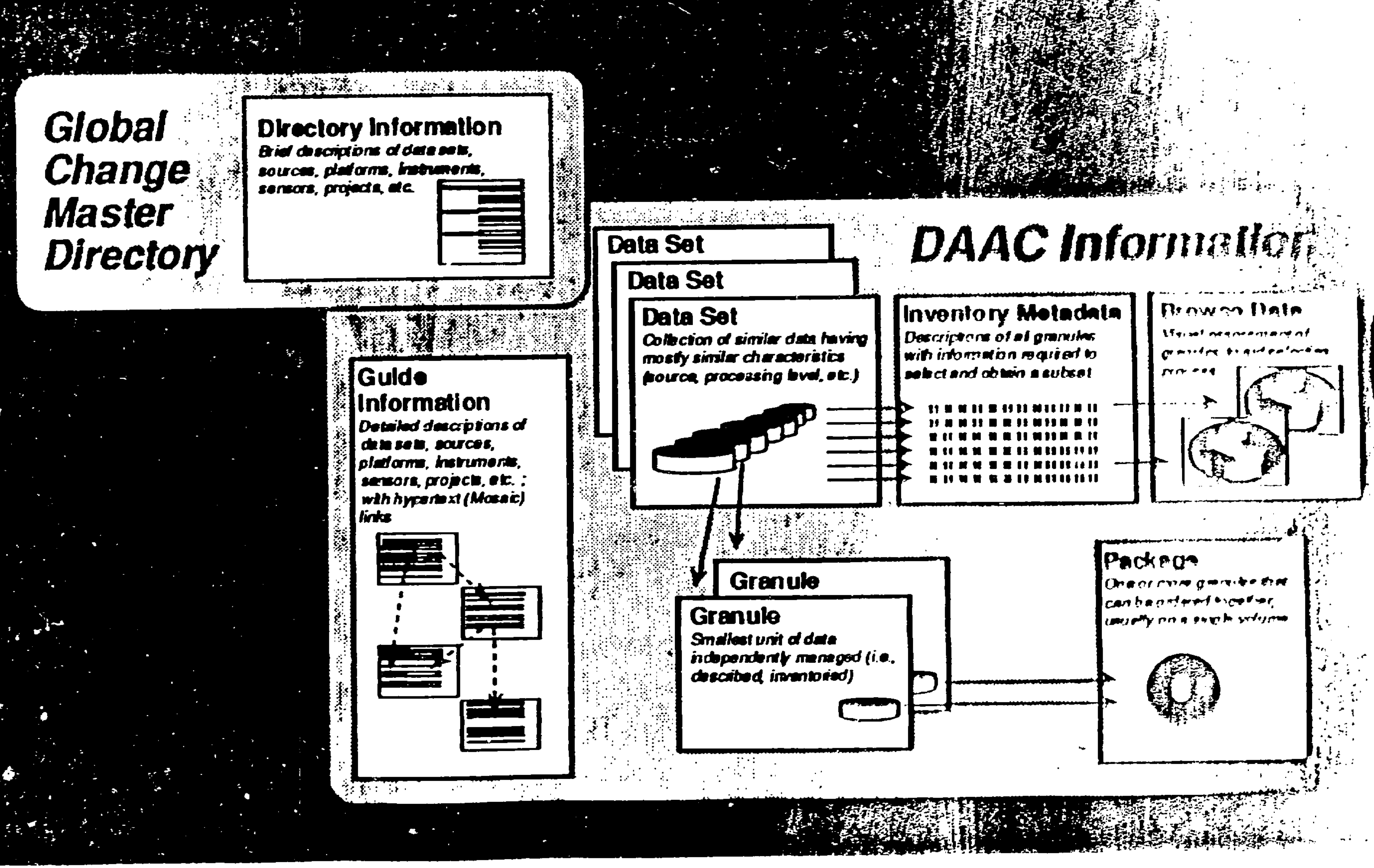
* ECS provides toolkits to appropriate SCFs

EOSDIS Version 0

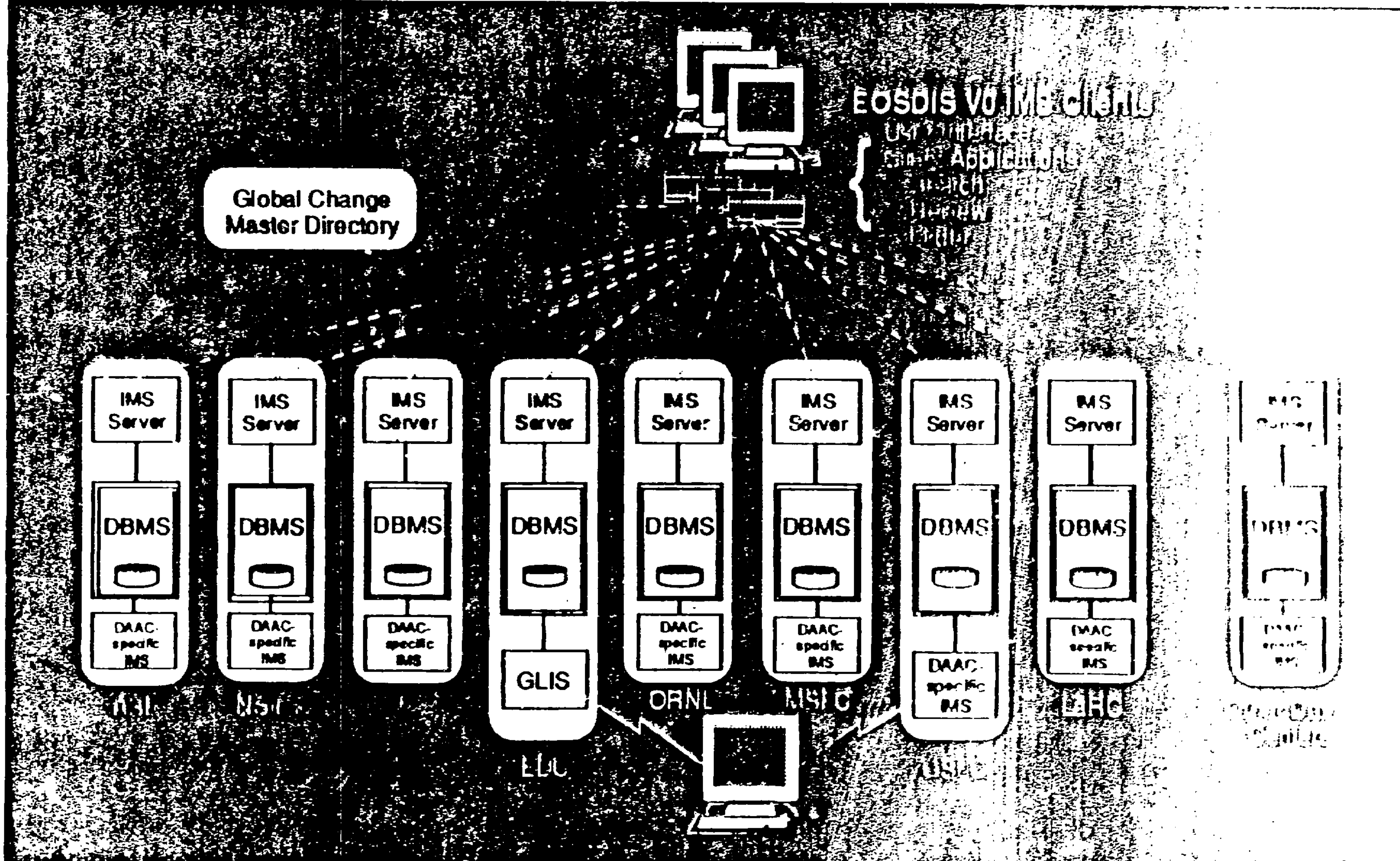
IMS Task Overview

- Initiated in FY91 during the definition of the EOSDIS Core System (ECS)
- Goals
  - Prototype uniform search and order access to data held at Version 0 Distributed Active Archive Centers (DAACs).
  - Provide operational capability to general EOS science community in July 1994.
  - Solicit input from the user community during the design and operation of the Version 0 elements.
  - Gain experience that can be applied to ECS.
- Series of Releases
  - Proof-of-concept of selected interoperability model.
  - Incremental development of data search and order functions.
  - Operational release defined by original set of requirements, science feedback, and lessons learned.

EOSDIS IMS V0
Lexicon of Information



EOSDIS IMS V0
Client/Server System



EOSDIS Version 0

IMS System Overview

Functions

Directory Search - Retrieve summary information on data sets that meet specified search criteria (source, parameter, spatial and temporal coverage, etc.).

Inventory Search - Retrieve information on specific granules of a data set (i.e. predefined subsets such as scenes, orbits, grids, etc.) based on search criteria.

Guide Search - Retrieve and review supplementary documentation as an initial keyword search or to access more information during a directory or inventory search.

Visual Aids

- **Geographical Search -** Graphically specify area of interest.
- **Geographical Coverage -** Graphically display granule coverage.
- **Browse -** Retrieve and display precomputed browse product to preview specific granules.

Results Integration - Sort, merge, and select from inventory results.

Product Request - Select granules, specify options, and place an order for data at the data centers.

EOSDIS Version 0

IMS System Overview

Features

Client-Server Model -	Information in the Global Change Master Directory (GCMD) and DAAC servers is accessed from standard IMS client. Client software will reside at DAACs or on user's workstations.
Message Passing Approach -	Communication between client and servers via standard "keyword=value" messages. Reused "Object Definition Language (ODL)" developed for an earlier NASA project. No modification to servers required except capability to map to and from messages and local system.
Alphanumeric and Graphical User Interfaces -	Basic search and order services (minus visual aids) provided through an alphanumeric interface.
Guide Software Reuse -	Text search and hypertext navigation built upon existing information resource discovery tools (Wide Area Information Servers (WAIS) and World-Wide-Web (WWW) and X-Mosaic).

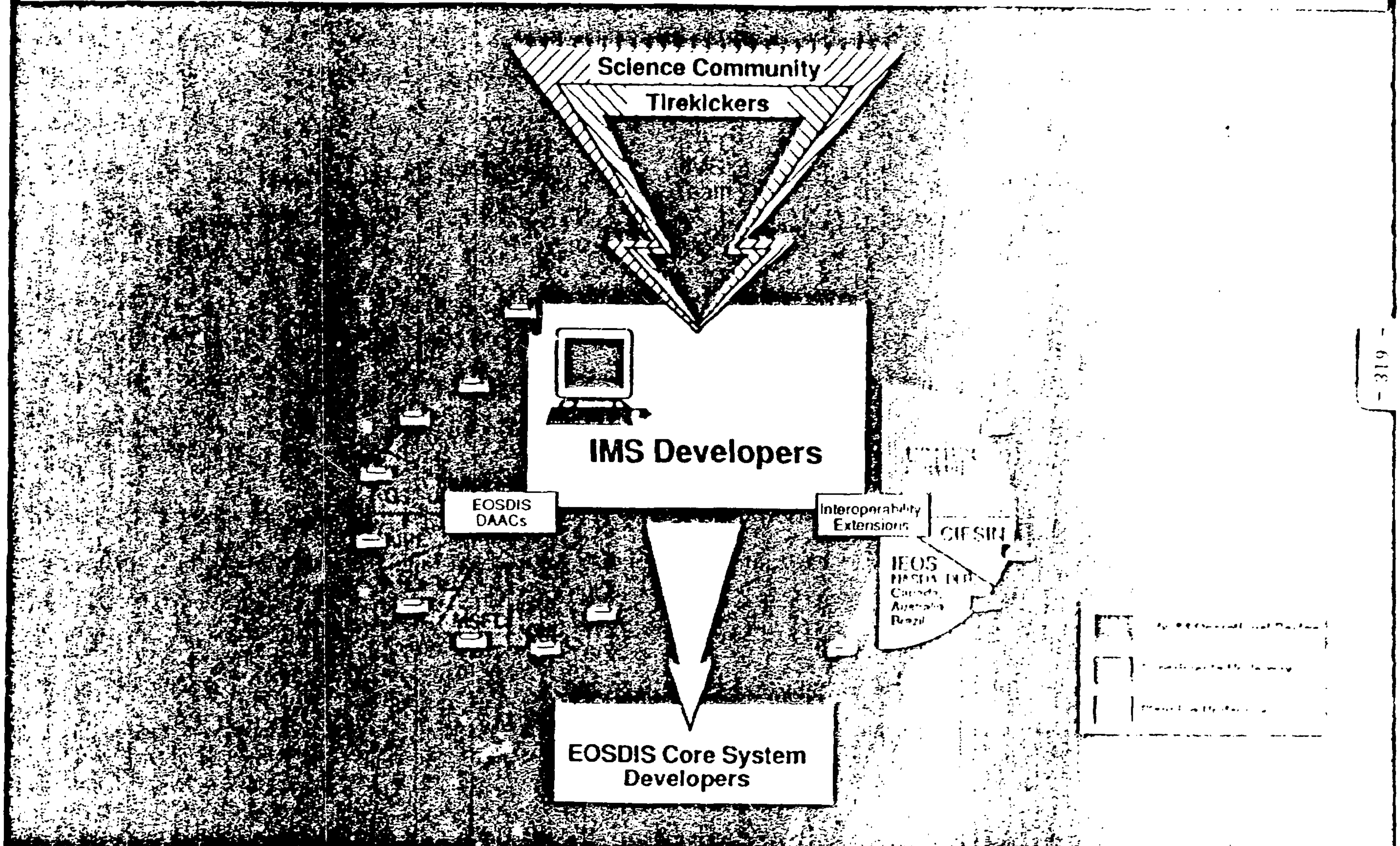
EOSDIS Version 0

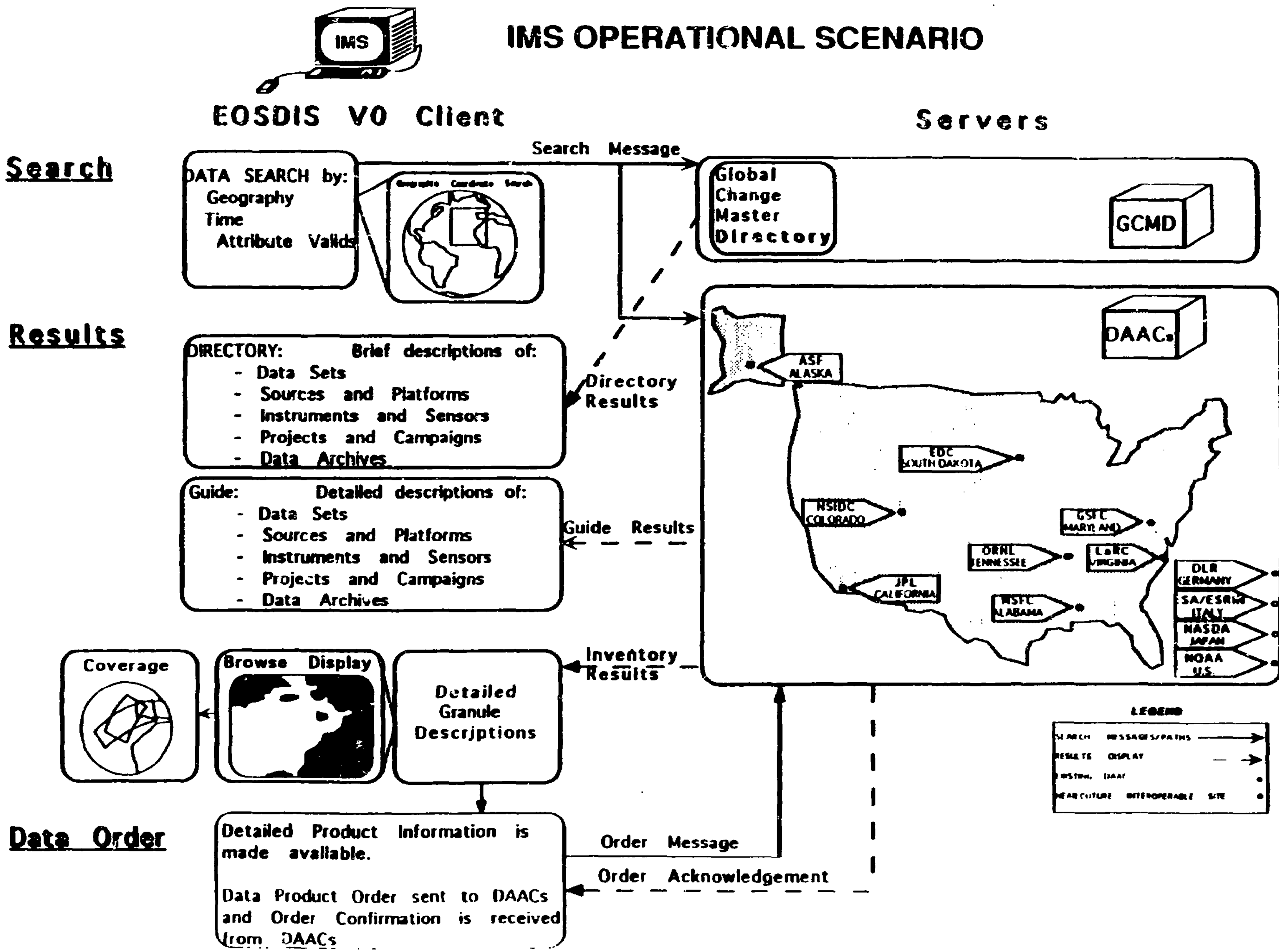
IMS System Overview

Characteristics

Client -	Developed on multiple UNIX workstations but currently running on single SGI.
	Graphical user interface developed with U/IMX.
	Local data management uses public domain software.
	Static information - dependent valids, request options, routing information...
	Dynamic information - result sets.
Servers -	Heterogeneous hardware and software.
	All using Relational Database Management Systems but different commercial packages.
	Some similarities in data and functions but non-standard terminology, attributes, schemas, etc.

EOSDIS IMS V0
The IMS Team




IMS
IMS OPERATIONAL SCENARIO
EOSDIS V0 Client
Servers
Search
Results
Data Order
DATA SEARCH by:
Geography
Time
Attribute Valids
Search Message
Global Change Master Directory
GCMD
DAACs
ASF ALASKA
EDC SOUTH DAKOTA
NSIDC COLORADO
GSFC MARYLAND
ORNL TENNESSEE
LaRC VIRGINIA
JPL CALIFORNIA
MSFC ALABAMA
DLR GERMANY
SA/ESRIN ITALY
NASDA JAPAN
NOAA U.S.
Directory Results
DIRECTORY: Brief descriptions of:
- Data Sets
- Sources and Platforms
- Instruments and Sensors
- Projects and Campaigns
- Data Archives
Guide Results
Guide: Detailed descriptions of:
- Data Sets
- Sources and Platforms
- Instruments and Sensors
- Projects and Campaigns
- Data Archives
Inventory Results
Coverage
Browse Display
Detailed Granule Descriptions
LEGEND
Detailed Product Information is made available.
Data Product Order sent to DAACs and Order Confirmation is received from DAACs
Order Message
Order Acknowledgement

EOSDIS

Earth Observing System Data and Information System

Socio-Economic Data and Applications Center (SEDAC)
CIESIN
Consortium for International Earth Science Information Network
2250 Pierce Road
University Center, MI 48710
User Support Office Contact:
Dennis Hauser
internet—ciesin.info@ciesin.org
tel—(517) 797-2700
fax—(517) 797-2622

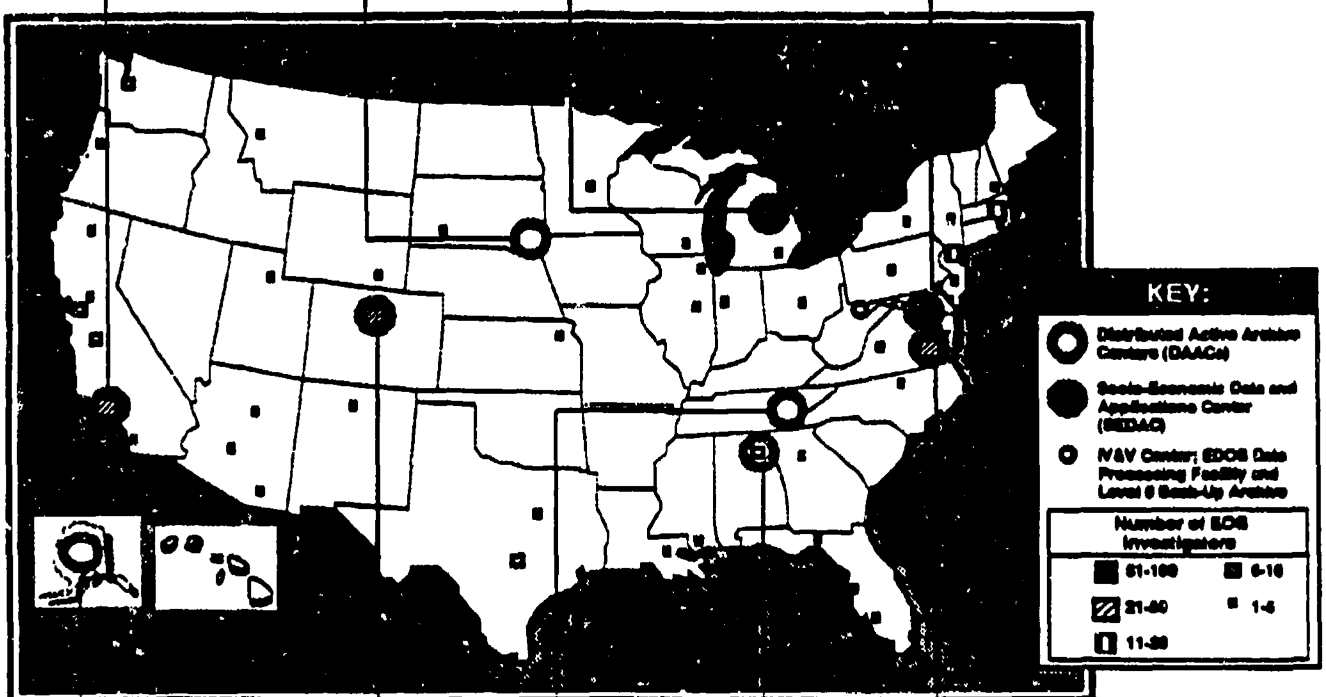
GCMD
Global Change Master Directory
Information about Earth science data sets and data centers.
NASA/Goddard Space Flight Center
Code 633
Greenbelt, MD 20771
User Support Office Contact:
Angela Bland
nsi/decnet—ncf::bland
internet—bland@nssdca.gsfc.nasa.gov
tel—(301) 513-1687

GCMD is a starting point for identifying data centers that archive and distribute Earth science data sets. It also provides high-level information about these data sets.

JPL DAAC
Ocean Circulation and Air-Sea Interaction
Jet Propulsion Laboratory
MS 300-320
4800 Oak Grove Drive
Pasadena, CA 91109
User Support Office Contact:
Ruby A. Lassanyi
nsi/decnet—ahmmp::ral
omnet—po.daac.jpl
internet—
ral@ahmmp.jpl.nasa.gov
tel—(818) 354-0808
fax—(818) 393-6720

GSFC DAAC
Upper Atmosphere, Atmospheric Dynamics, Global Biosphere, Geophysics
NASA/Goddard Space Flight Center
Code 936
Greenbelt, MD 20771
User Support Office Contact:
Jim Closs
nsi/decnet—ncf::daacuso
internet—
daacuso@nssdca.gsfc.nasa.gov
tel—(301) 286-3209
fax—(301) 286-3221

EDC DAAC
Land Processes Imagery
United States Geological Survey
EROS Data Center
Sioux Falls, SD 57198
User Support Office Contact: Ron Risty
internet—risty@edcserver1.cr.usgs.gov
tel—(605) 594-6607



ASF DAAC
Sea Ice, Polar Processes Imagery (SAR)
Alaska SAR Facility
Geophysical Institute
GeoData Center
University of Alaska
Fairbanks, AK 99775-0800
User Support Office Contact:
Rose Watabe
nsi/decnet—eama::rwatabe
omnet—asf.center
internet—
rwatabe@eama.asf.alaska.edu
tel—(907) 474-7487
fax—(907) 474-7290

NSIDC DAAC
Cryosphere (non-SAR)
National Snow and Ice Data Center
CIRES, Campus Box 449
University of Colorado
Boulder, CO 80309
User Support Office Contact:
Claire Hanson
nsi/decnet—kryos::hanson
internet—
hanson@kryos.colorado.edu
tel—(303) 492-1834
fax—(303) 492-2468

Oak Ridge DAAC
Biogeochemical Dynamics
Oak Ridge National Laboratory (ORNL)
Environmental Sciences Division
MS6490
Oak Ridge, TN 37831-6490
User Support Office Contact:
Paul Kanciruk
omnet—p.kanciruk
internet—pidu@ornl.gov
tel—(615) 574-7817
fax—(615) 574-4665

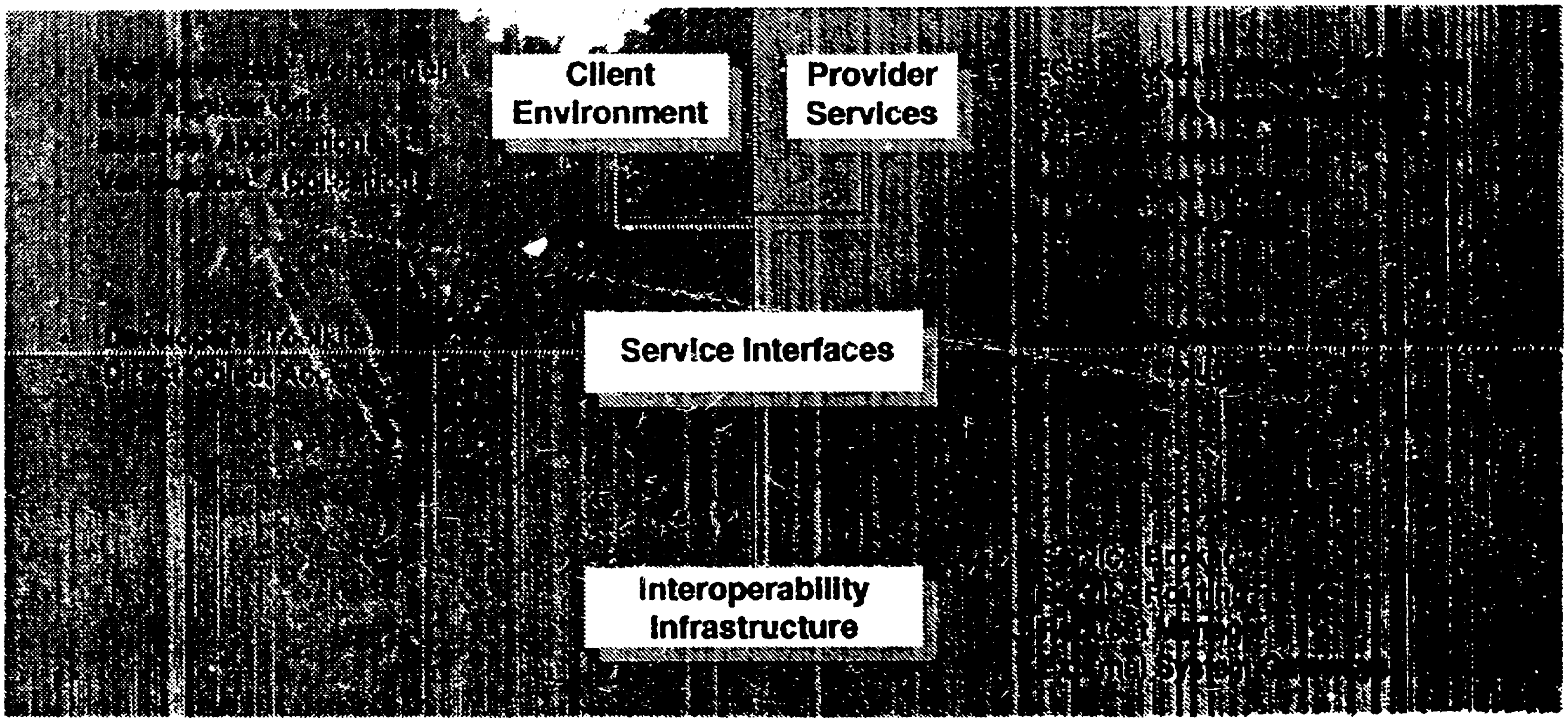
MSFC DAAC
Hydrologic Cycle
NASA/Marshall Space Flight Center
Code ES44
Huntsville, AL 35812
User Support Office Contact:
Vada LaFontaine
nasamail—vlafontaine
tel—(205) 544-4086
fax—(205) 544-5148

LaRC DAAC
Radiation Budget, Aerosols, Tropospheric Chemistry
NASA/Langley Research Center
Mail Stop 157B
Hampton, VA 23665-5225
User Support Office Contact:
Lisa Mering
internet—userservices
@magician.larc.nasa.gov
tel—(804) 864-8656
fax—(804) 864-8807

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland

91-0605-TL-Ver 05

ECS User-Provider Model



SDS - 4.5.2 / 4.5.3

Interoperability & Data Management

Find services and data - retrieve service representation

- *Advertising Service*

Get explanations of terms

- *Data Dictionary Service*

[Get Direct Access to a Collection

- *Data Server Service*]

Search several collections at a site + provide site autonomy

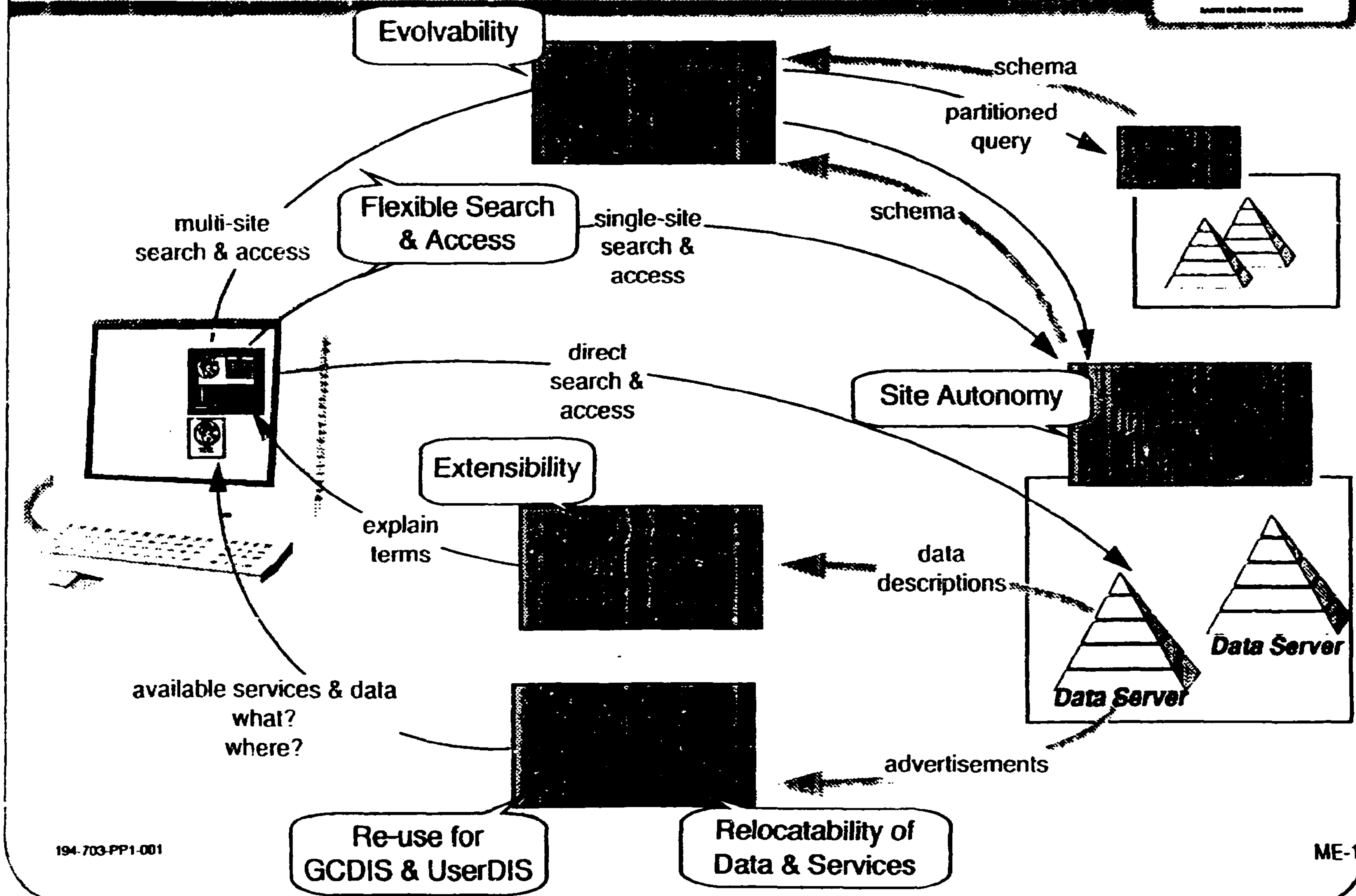
- *Local Information Management Service*

Multi-site searching

- *Distributed Information Management Service*

SDS - 4.5.2 / 4.5.3

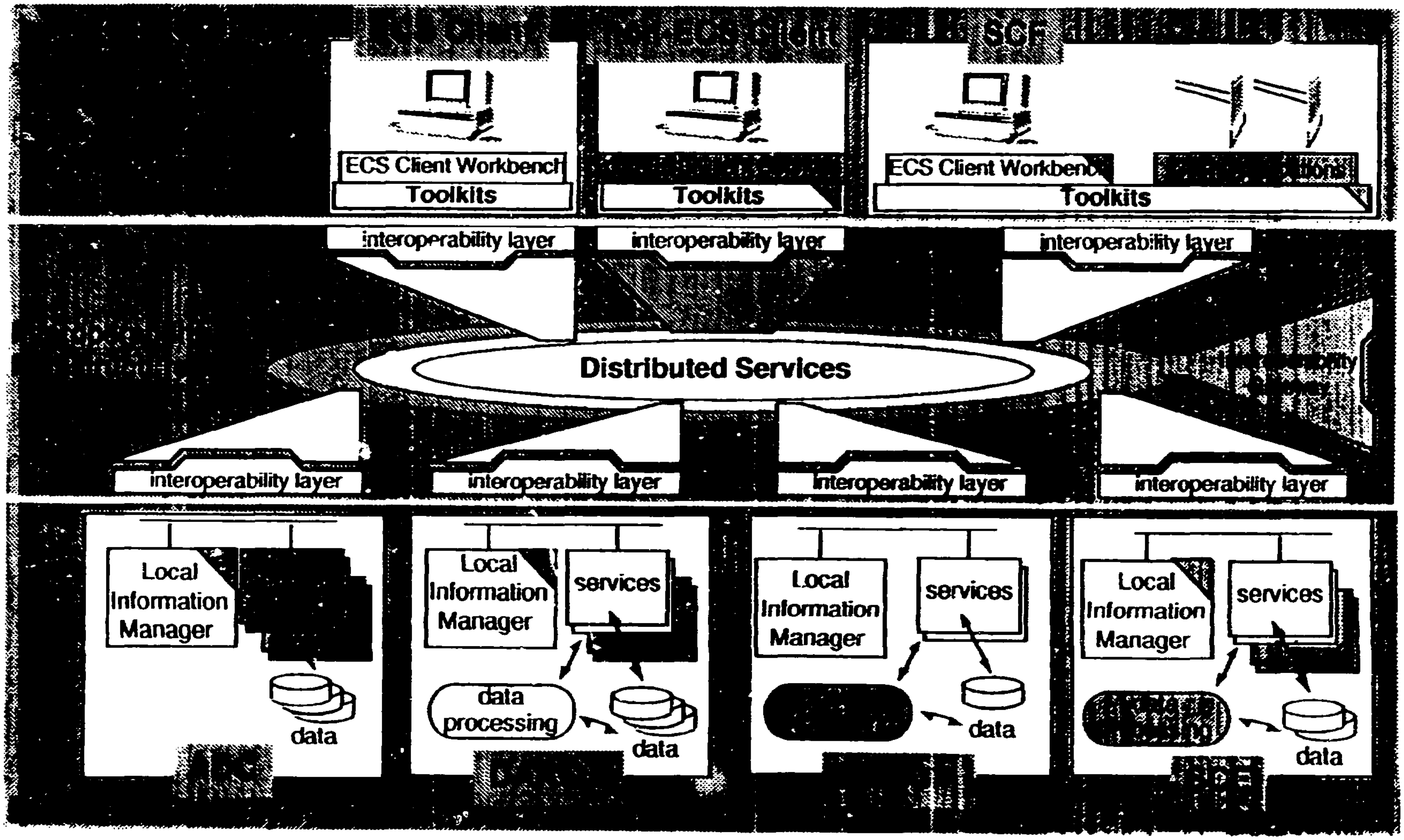
Interoperability & Data Management



194-703-PP1-001

ME-1

ECS Conceptual Architecture



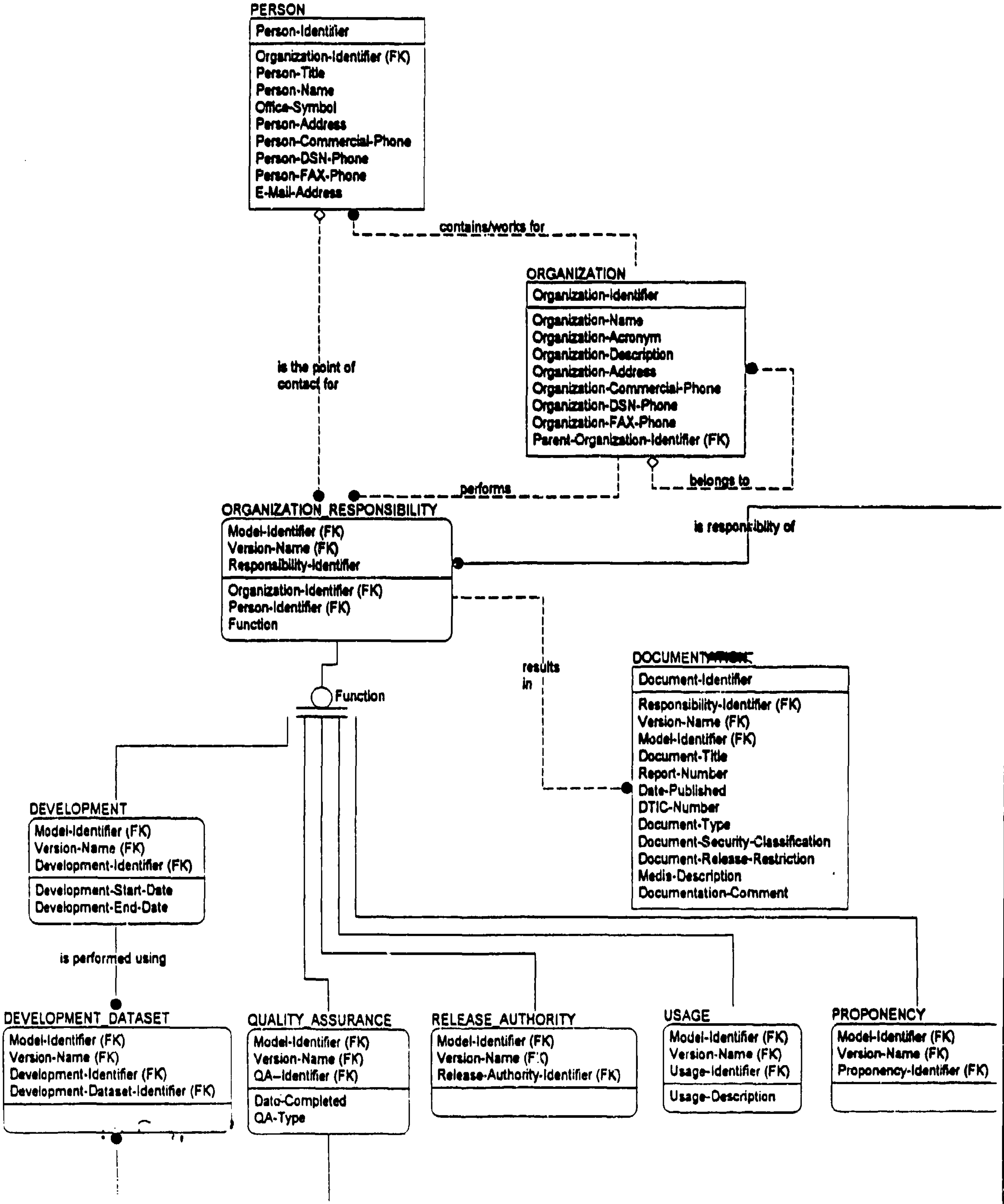
LATEST IDEFIX DATA MODELS FOR

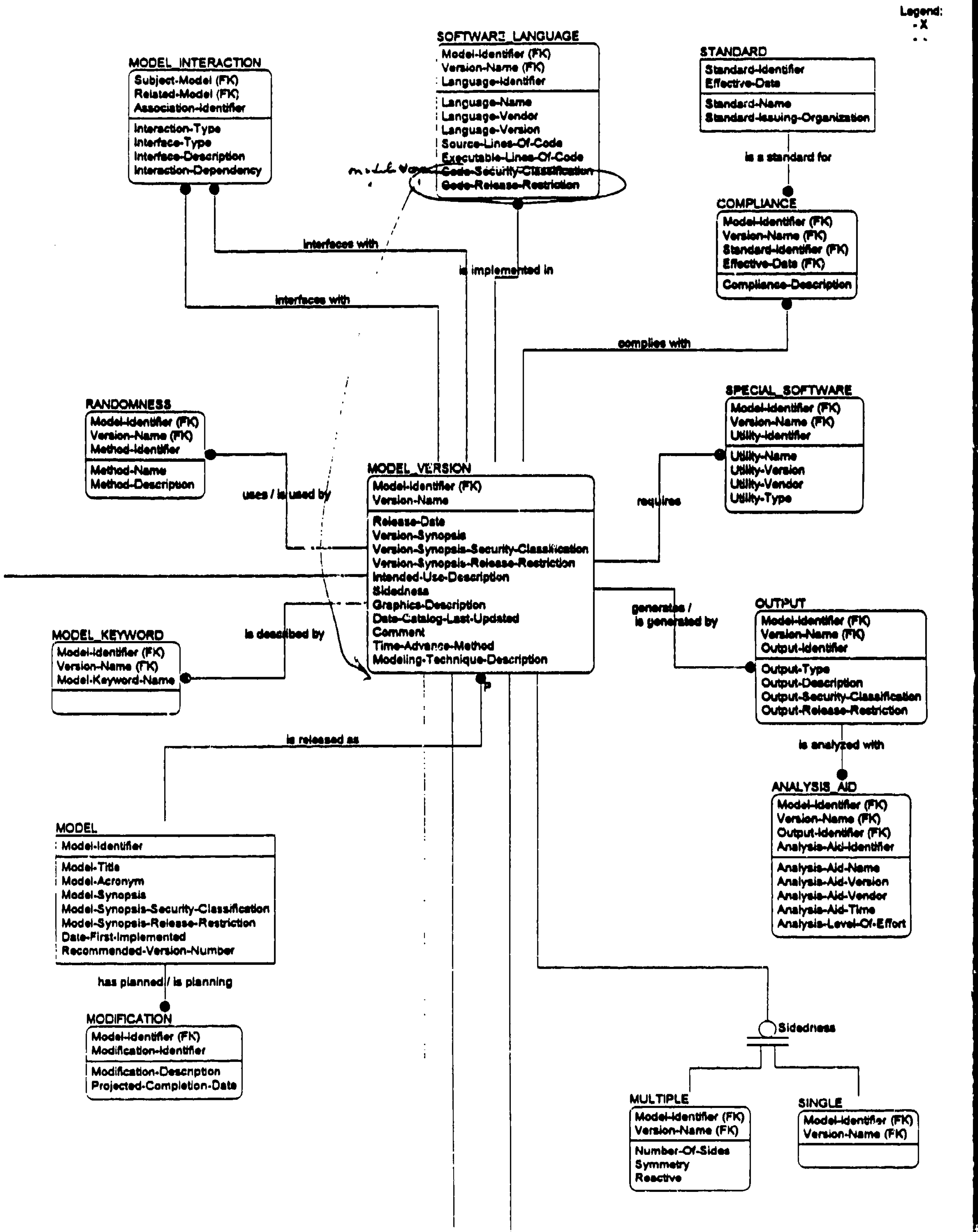
- **M&S DIRECTORY**
- **DATA BASE DIRECTORY**
- **DIS EXERCISE**

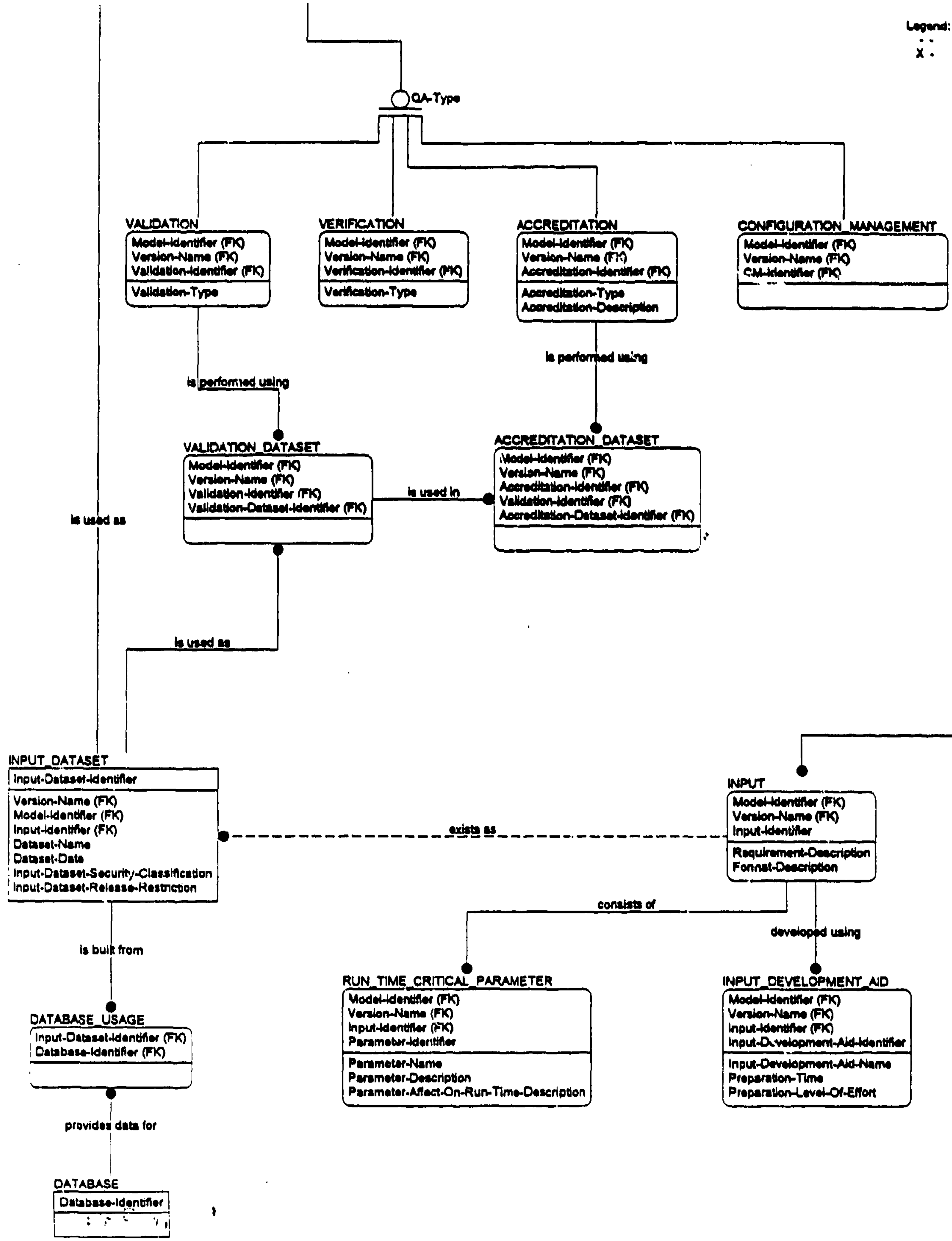
DMSO Model & Simulation Directory
Fully Attributed Logical Data Model

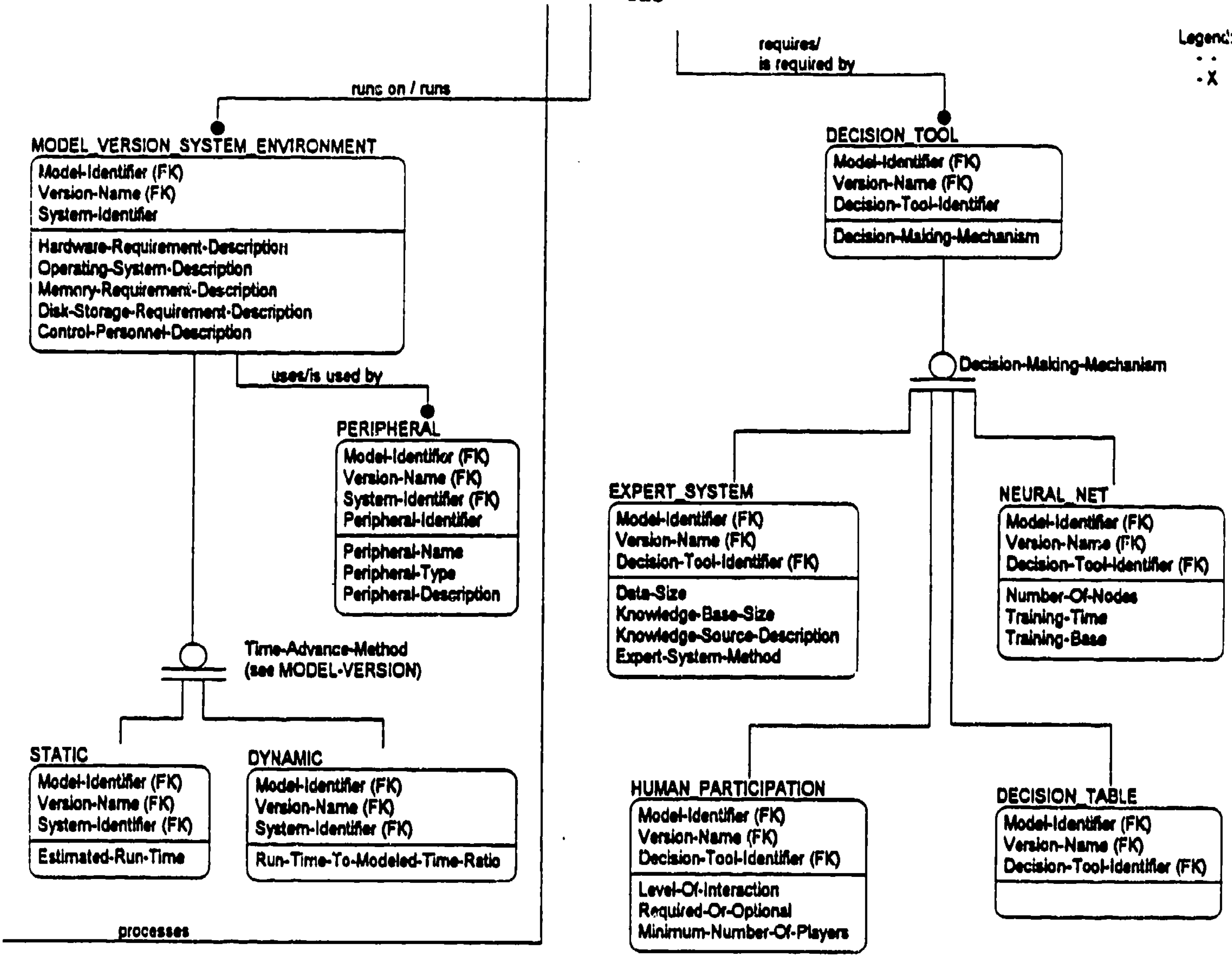
Developed by USASSDC/CREO: 10 Jan 94
Modified by JDBE: 8 July 94

Legend:
X -
- -



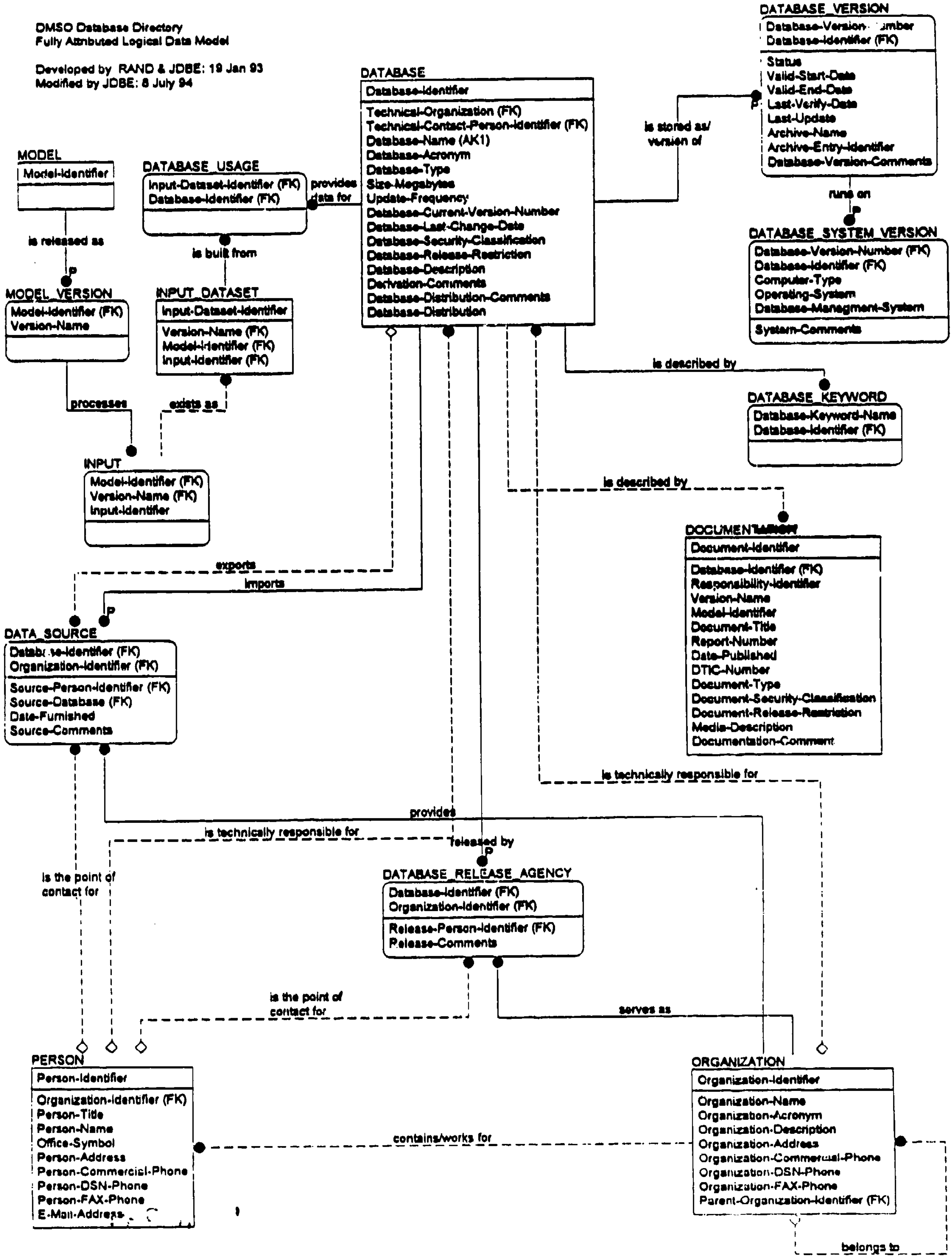

Legend:
- X
SOFTWARE_LANGUAGE
Model-Identifier (FK)
Version-Name (FK)
Language-Identifier
Language-Name
Language-Vendor
Language-Version
Source-Lines-Of-Code
Executable-Lines-Of-Code
Code-Security-Classification
Code-Release-Restriction
STANDARD
Standard-Identifier
Effective-Date
Standard-Name
Standard-Issuing-Organization
MODEL_INTERACTION
Subject-Model (FK)
Related-Model (FK)
Association-Identifier
Interaction-Type
Interface-Type
Interface-Description
Interaction-Dependency
is a standard for
COMPLIANCE
Model-Identifier (FK)
Version-Name (FK)
Standard-Identifier (FK)
Effective-Date (FK)
Compliance-Description
interfaces with
is implemented in
interfaces with
complies with
RANDOMNESS
Model-Identifier (FK)
Version-Name (FK)
Method-Identifier
Method-Name
Method-Description
SPECIAL_SOFTWARE
Model-Identifier (FK)
Version-Name (FK)
Utility-Identifier
Utility-Name
Utility-Version
Utility-Vendor
Utility-Type
uses / is used by
requires
MODEL_VERSION
Model-Identifier (FK)
Version-Name
Release-Date
Version-Synopsis
Version-Synopsis-Security-Classification
Version-Synopsis-Release-Restriction
Intended-Use-Description
Sidedness
Graphics-Description
Data-Catalog-Last-Updated
Comment
Time-Advance-Method
Modeling-Technique-Description
generates /
is generated by
OUTPUT
Model-Identifier (FK)
Version-Name (FK)
Output-Identifier
Output-Type
Output-Description
Output-Security-Classification
Output-Release-Restriction
MODEL_KEYWORD
Model-Identifier (FK)
Version-Name (FK)
Model-Keyword-Name
is described by
P
is released as
is analyzed with
ANALYSIS_AID
Model-Identifier (FK)
Version-Name (FK)
Output-Identifier (FK)
Analysis-Aid-Identifier
Analysis-Aid-Name
Analysis-Aid-Version
Analysis-Aid-Vendor
Analysis-Aid-Time
Analysis-Level-Of-Effort
MODEL
Model-Identifier
Model-Title
Model-Acronym
Model-Synopsis
Model-Synopsis-Security-Classification
Model-Synopsis-Release-Restriction
Date-First-Implemented
Recommended-Version-Number
has planned / is planning
MODIFICATION
Model-Identifier (FK)
Modification-Identifier
Modification-Description
Projected-Completion-Date
Sidedness
MULTIPLE
Model-Identifier (FK)
Version-Name (FK)
Number-Of-Sides
Symmetry
Reactive
SINGLE
Model-Identifier (FK)
Version-Name (FK)


Legend:
QA-Type
VALIDATION
Model-Identifier (FK)
Version-Name (FK)
Validation-Identifier (FK)
Validation-Type
VERIFICATION
Model-Identifier (FK)
Version-Name (FK)
Verification-Identifier (FK)
Verification-Type
ACCREDITATION
Model-Identifier (FK)
Version-Name (FK)
Accreditation-Identifier (FK)
Accreditation-Type
Accreditation-Description
CONFIGURATION_MANAGEMENT
Model-Identifier (FK)
Version-Name (FK)
CM-Identifier (FK)
is performed using
is performed using
VALIDATION_DATASET
Model-Identifier (FK)
Version-Name (FK)
Validation-Identifier (FK)
Validation-Dataset-Identifier (FK)
is used in
ACCREDITATION_DATASET
Model-Identifier (FK)
Version-Name (FK)
Accreditation-Identifier (FK)
Validation-Identifier (FK)
Accreditation-Dataset-Identifier (FK)
is used as
is used as
INPUT_DATASET
Input-Dataset-Identifier
Version-Name (FK)
Model-Identifier (FK)
Input-Identifier (FK)
Dataset-Name
Dataset-Date
Input-Dataset-Security-Classification
Input-Dataset-Release-Restriction
exists as
INPUT
Model-Identifier (FK)
Version-Name (FK)
Input-Identifier
Requirement-Description
Format-Description
consists of
developed using
is built from
RUN_TIME_CRITICAL_PARAMETER
Model-Identifier (FK)
Version-Name (FK)
Input-Identifier (FK)
Parameter-Identifier
Parameter-Name
Parameter-Description
Parameter-Affect-On-Run-Time-Description
INPUT_DEVELOPMENT_AID
Model-Identifier (FK)
Version-Name (FK)
Input-Identifier (FK)
Input-Development-Aid-Identifier
Input-Development-Aid-Name
Preparation-Time
Preparation-Level-Of-Effort
DATABASE_USAGE
Input-Dataset-Identifier (FK)
Database-Identifier (FK)
provides data for
DATABASE
Database-Identifier


Legend:
runs on / runs
requires/
is required by
MODEL_VERSION_SYSTEM_ENVIRONMENT
Model-Identifier (FK)
Version-Name (FK)
System-Identifier
Hardware-Requirement-Description
Operating-System-Description
Memory-Requirement-Description
Disk-Storage-Requirement-Description
Control-Personnel-Description
uses/is used by
PERIPHERAL
Model-Identifier (FK)
Version-Name (FK)
System-Identifier (FK)
Peripheral-Identifier
Peripheral-Name
Peripheral-Type
Peripheral-Description
Time-Advance-Method
(see MODEL-VERSION)
STATIC
Model-Identifier (FK)
Version-Name (FK)
System-Identifier (FK)
Estimated-Run-Time
DYNAMIC
Model-Identifier (FK)
Version-Name (FK)
System-Identifier (FK)
Run-Time-To-Modeled-Time-Ratio
processes
DECISION_TOOL
Model-Identifier (FK)
Version-Name (FK)
Decision-Tool-Identifier
Decision-Making-Mechanism
Decision-Making-Mechanism
EXPERT_SYSTEM
Model-Identifier (FK)
Version-Name (FK)
Decision-Tool-Identifier (FK)
Data-Size
Knowledge-Base-Size
Knowledge-Source-Description
Expert-System-Method
NEURAL_NET
Model-Identifier (FK)
Version-Name (FK)
Decision-Tool-Identifier (FK)
Number-Of-Nodes
Training-Time
Training-Base
HUMAN_PARTICIPATION
Model-Identifier (FK)
Version-Name (FK)
Decision-Tool-Identifier (FK)
Level-Of-Interaction
Required-Or-Optional
Minimum-Number-Of-Players
DECISION_TABLE
Model-Identifier (FK)
Version-Name (FK)
Decision-Tool-Identifier (FK)

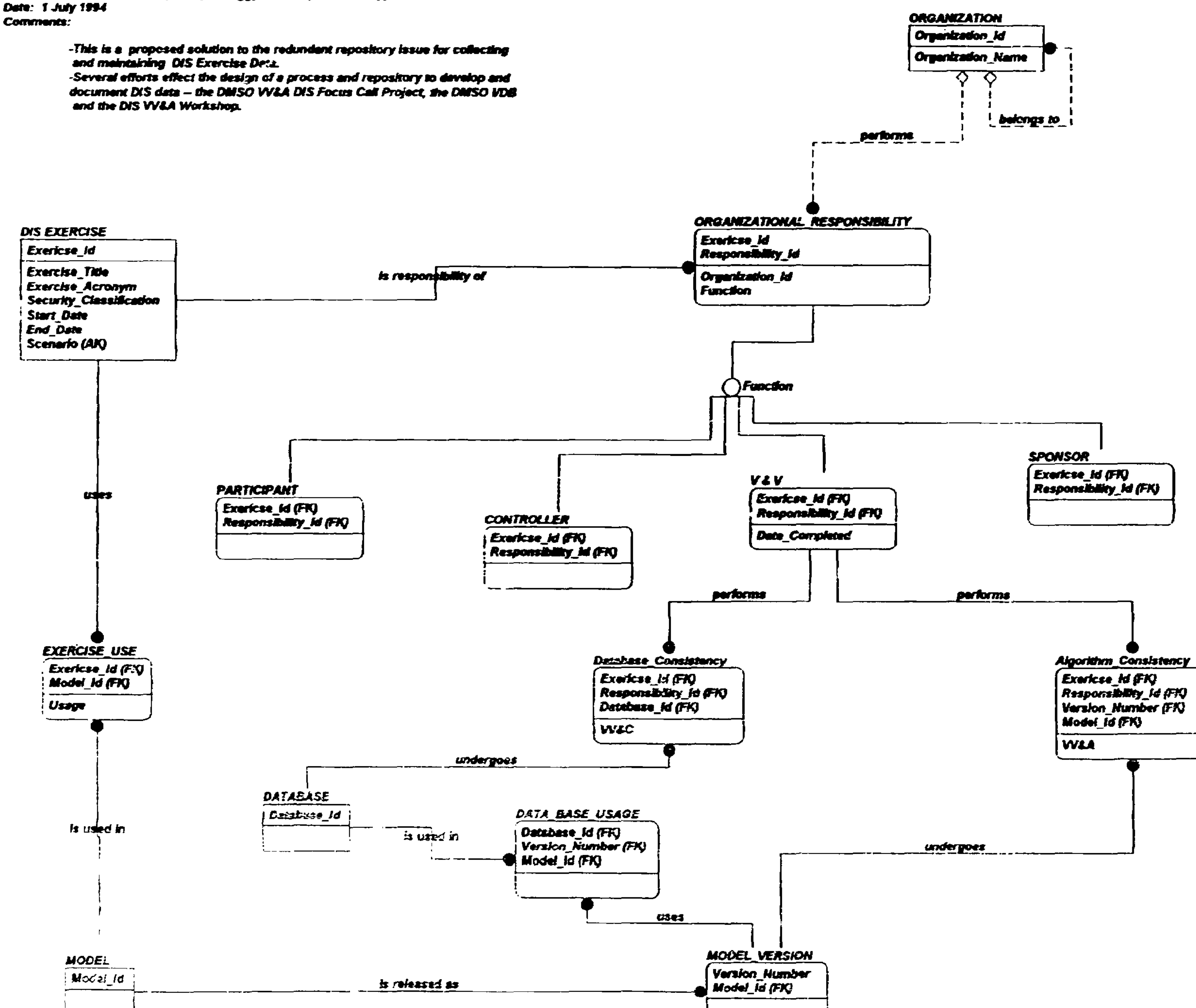
DMSO Database Directory
Fully Attributed Logical Data Model

Developed by RAND & JDBE: 19 Jan 93
Modified by JDBE: 8 July 94



DIS Exercise Data Model
Author: MAJ Walt Swindell (TRAC) & Peggy Gravitz (COLSA Corp)
Date: 1 July 1994
Comments:

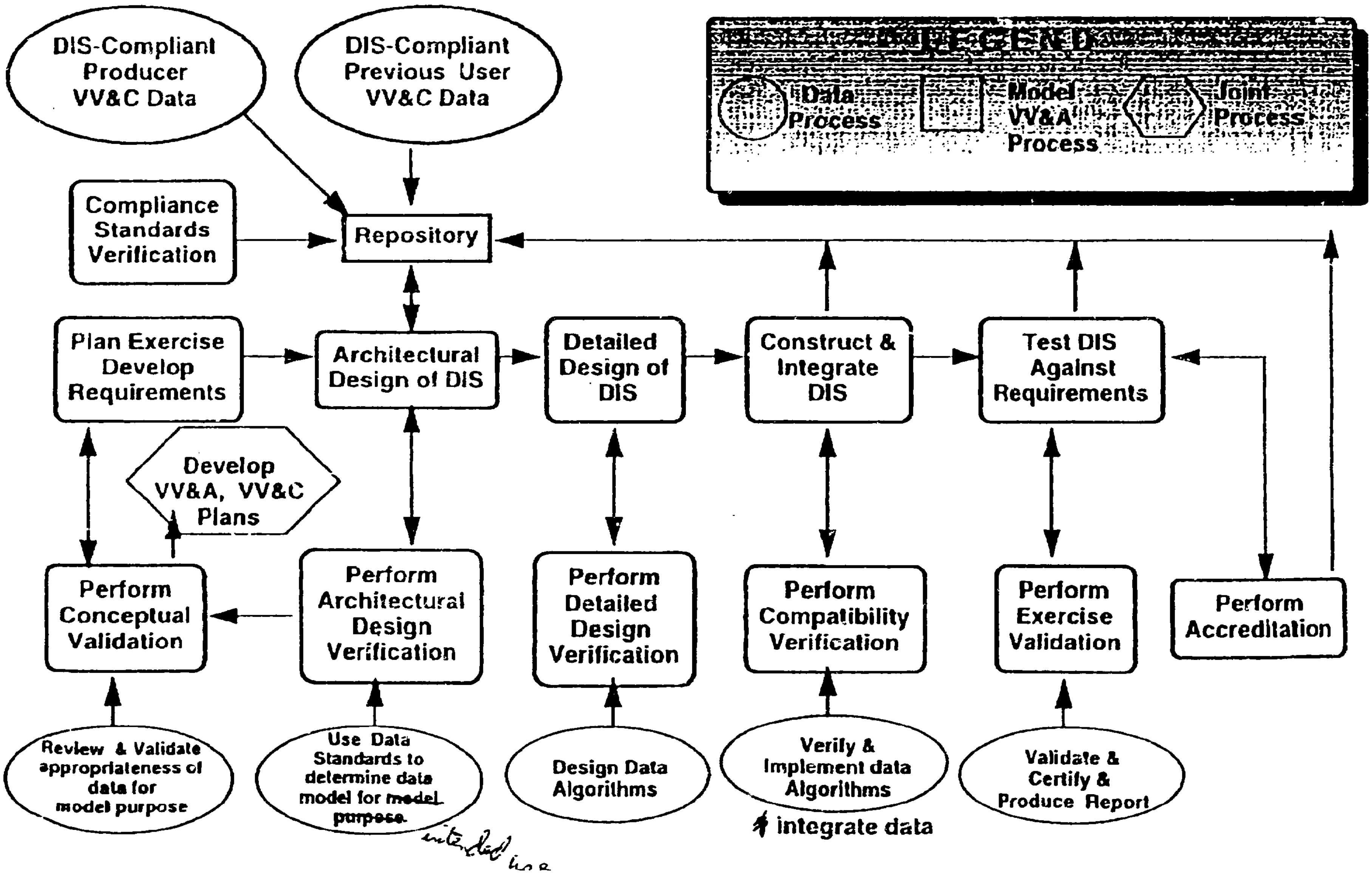
-This is a proposed solution to the redundant repository issue for collecting and maintaining DIS Exercise Data.
-Several efforts effect the design of a process and repository to develop and document DIS data -- the DMSO VV&A DIS Focus Call Project, the DMSO VDB and the DIS VV&A Workshop.



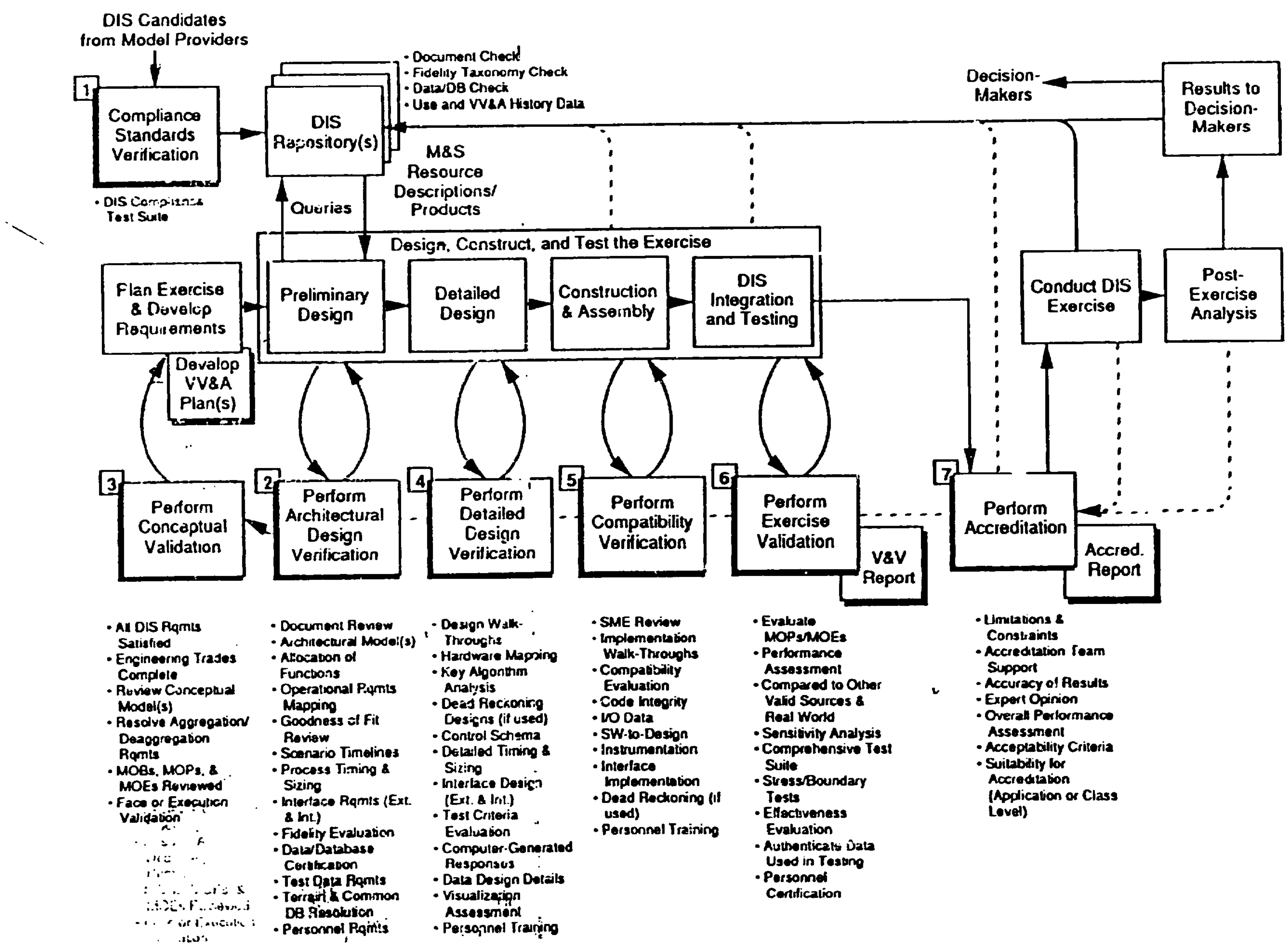
APPENDIX D: SUBGROUP ON DATA VV&C GUIDELINES BRIEFING CHARTS

Bob Hartline : DIS Process

DISTRIBUTED INTERACTIVE SIMULATION
COMBINED MODEL VV&A — DATA VV&C PROCESS



Applying the VV&A Process to a DIS Exercise



VV&A Quick Planner ©

Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
1. Compliance Verification					
• DIS I/F Compliance Test	- Run standard test suite	DIS I/F compliance test			
• Fidelity Taxonomy	- Inspect for completeness and accuracy of characterization	Fidelity taxonomy			
• Documentation Check,	- List what was supplied - Determine what is necessary: • User - hi-level (Evaluate) • Maintainer - low-level (Evaluate) - Determine what should be developed to supplement missing documentation				
• Data/DB Check	- Verify data and database needs for the proposed application - Run quality tests on data to ensure ranges, accuracies, scalar values, etc. are correct and within acceptable limits - Ensure that M&S will run with DIS network data without corruption	Decode data/DB by field in ASCII Database analysis tool (usually custom built)			
• Use and VV&A History Data Check	- Determine when and with what test suite and scenario it was used? - Examine any SPR history? - Examine VV&A History: records, reports etc. - If none, decide if added verification is required and appropriate (see next activity)	CM records VV&A records Test records User records			
• Remedial Verification	- Perform confidence assessment from all 5 steps above; if M&S product lacks prior VV&A history, determine type and amount of remedial verification needed - Perform remedial verification such as static code analysis, documentation augmentation, request test suite from owner, etc. Tailor approach to individual product requirements	Static code analyzer(s)			

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
2. Architectural Verification					
• Architectural Models	- Evaluate and verify existing models, e.g. object, data & behavioral diagrams - If inadequate, "consider development of a meta model by V&V to ensure completeness, I/F definition, behavior/timelines, etc. and the data to be exchanged over the DIS network. Meta model can be one of several forms--functional block, data flow, entity-relationship, or object model diagrams	Use tool outputs and/or existing documentation Develop Meta Model using appropriate CASE tool			
• Allocation of Functions	- Allocation begins with tracing requirements from process block 1 - Next, verify that all rqmts are allocated to DIS functions - Any inconsistencies are noted and corrections recommended where obvious. Document deficiencies in SPR	Decomposition methodology Requirements tracing DB			
• Operational Rqmts Mapping	- Based on Session or Exercise Requirements, determine if all operational rqmts are completely mapped into the Architecture - Verify these for correctness based on desired behavior of exercise	Requirements tracing DB Behavioral model or control flow diag.			
• Scenario Timeline	- Evaluate and verify the scenario timeline. If necessary, generate event sequence diagram. What processes and tasks have to run, when, etc. What deadlines are involved, etc. - Verify the overall scenario description for adequacy	Event sequence diagram			
• Rough Timing and Sizing	- Verify initial timing estimates; use measured data where available. Similarly, estimate sizing implications on the hardware to be used. Determine adequacy	Timing and sizing data			

CN-49-02

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
2. Architectural Verification (Continued)					
• Interface Requirements	- Verify that all DIS components are interfaced correctly - Ensure all data elements/values to be used are correctly defined and within protocol boundaries - Verify ICD or similar interconnect diagram; if not available, consider generating one	DIS I/F compliance test Database analysis tool Generate ICD; use appropriate tool when available			
• Fidelity Evaluation	- Inspect the Fidelity Taxonomy for completeness and characterization of component descriptions to ensure goodness of fit and determine expected fidelity during testing	Fidelity taxonomy			
• Requirements Traceability	- Build database of both operational and functional requirements linked to the architectural models to ensure adequacy of tracing into the design	Requirement tracing DB, (use any of many available database management systems)			

CN-49-03

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
4. Detailed Design Verification					
• Design Walkthroughs	- Participate in Design Walkthroughs when held by process integrator to promote full understanding of DIS process, or if necessary request similar activity from M&S owners on especially complex components	Structured walkthroughs Peer reviews			
• Interface Design Analysis	- Verify the design of each Interface including the DIS PDUs being used - Details of each data transfer and message are verified - Verify that massages embedded in particular PDUs are handled correctly (encoded & decoded)	Use DIS I/F stds Database analysis tool Detailed SW analysis			
• Hardware Mapping	- Software-to-Hardware mapping is verified; deficiencies are recorded and become SPRs - Recommend rebalancing SW loading maps to improve processing where appropriate	Loading maps			
• Key Algorithm Analysis	- Perform detailed mathematical proofs and analysis of key algorithms - If necessary, implement and test on tool-bearing host - Use reference sources & prior experience - Perform real world suitability evaluation and run-time assessment	Algorithm checks Code, run and evaluate Reference sources Static design analysis			
• Dead Reckoning Designs	- Determine the dead reckoning requirements - Inspect the designs for implementing the dead reckoning algorithms - Exercise the models to verify their operation - Determine thresholds for reasonableness - Estimate update roles in worst case situations; recalibrate if required	Rules for dead reckoning algorithms			

CN-49-04

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
4 ~~3~~. Detailed Design Verification (Continued)					
• Overall Control of Schema	- Examine overall control structure for completeness and accuracy of timing estimates - Examine the entire DIS architecture and overall timing template to ensure that execution will remain stable in worst case conditions	Static design analysis Timing data Event Sequence Diagram			
• SAFOR Scripts	- Determine min/max response timelines - Evaluate the scripting and other prompting to be provided by humans in the loop to ensure adequate responses and execution of DIS exercise - Recommend default actions, if/when participant fails to respond correctly	Rule base Exercise script Event sequence diagram Human engineering evaluation			
• Detailed Timing and Sizing	- Evaluate detailed timing and sizing data to ensure adequate hardware, interface, and network performance as the DIS is integrated and tested	Timing and sizing DB Recorded results			

CN-49-05

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
5 ~~4~~. Compatibility Verification					
• SME Review	- Using M&S and domain experts, evaluate the apparent compatibility of the DIS entities as well as their ability to meet the operational requirements	SMEs and domain experts			
• Compatibility Confirmed	- This may be confirmed incrementally during integration or as a netted test series - Observe and measure performance of DIS entities to ensure compatibility and interoperability - Define producer/consumer threads and evaluate the I/O needs of each to ensure compatibility	Id of key structural characteristics and outputs			
• Code Integrity Checks	- Review code static testing and repeat or augment this testing as required to ensure completeness and correctness - Conduct walkthrough with M&S owners on especially complex code - Concentrate verification on code changed during DIS integration and process construction	Static code analyzer			
• Dead Reckoning Implementation	- Verify the implementation of the dead reckoning algorithms and models - Ensure that trigger thresholds are optimized to match DIS network performance and update constraints - Test the actual performance of the dead reckoning models via netted tests	Dead reckoning algorithms Measurements of performance and phenomena Measure results			
• Input/Output Data Checks	- Confirm each data field, value, and range - If necessary develop a data test driver to simulate the network to ensure interoperability and correctness - Confirm that the PDUs selected for each data type are appropriate and properly implemented	Data exchange tests Database analysis tool			

CN-49-06

5

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
4. Compatibility Verification (Continued)					
• Software-to-Design Checks	- Verify that software matches the design documentation. If discrepancies are found, determine where fault lies and write SPRs - Requires programmers trained and proficient in implementation languages used in the DIS entities	Spec-to-code comparison			
• Instrumentation	- Determine necessary instrumentation and confirm its incorporation into the DIS at appropriate points - Determine if DIS network or other means should be provided to support data collection - Checkout and calibrate instrumentation just prior to use to ensure integrity	Hardware and software monitors Test instruments Calibration procedures			
• Interface Implementation	- Ensure that specified interconnections are physically linked - Ensure that proper PDUs are used to handle the data transfer requirements	ICD DIS I/F std			

CN-49-07

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
6 5. Acceptability Validation					
• Evaluate MOPs/MOEs	- Define a set of MOPs and MOEs that satisfy the functional and operational requirements of this application - Evaluate the DIS in terms of these MOPs and MOEs - Determine cause of any deficiencies detected	Generate MOPs and MOEs for this application Face validation			
• Performance Criteria	- Return to the Exercise Requirements database developed earlier in Architectural Verification phase and extract a set of performance test criteria for validation - Define a minimal set of tests that satisfy these criteria - Run the validation test suite - Collect and evaluate results	Performance tests Measurements of Phenomena Lab tests			
• Comparison to Other Validated Sources	- Where possible, acquire comparable M&S components for comparison tests with those in the DIS - Determine how closely the M&S should match and run tests using the same (equivalent) input data for comparison - Evaluate performance and determine if deficiencies exist. Write SPRs if required.	Comparison tests			
• Sensitivities/Boundaries	- During validation testing, determine the sensitivity of key DIS parameters - Experiment as resources allow by varying these parameters to optimize DIS configuration and operational scenario - Determine boundaries that if exceeded degrade the DIS performance	Sensitivity analysis Stress tests			

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
5. Acceptability Validation (Continued)					
• Scenario Scripted	- Review DIS integrator's scenario script if available; if not, generate one in order to define the sequencing, event queues, and message queues, etc. that drive the exercise - All human interaction should be scripted or at least given limits and response timelines	Scripts Event sequence diagram Timing template Face validation			
• Comprehensive Test Suite	- Define/develop a validation test suite that can be used sans the live components to benchmark and support regression testing of the DIS - Calibrate the contribution of live components from data collected during exercises for use in the test suite as default values for simulating them	Performance test Operational test Certification of input data			
• Real-World Comparison	- Using face validation and SMEs, evaluate the behavior and operation of the DIS to determine if it meets the real-world expectations required of it - Compare input and output data to known certified real-world sources - Determine if users generally agree that the behavior of the DIS entities is sufficient for the exercise	Turing tests Measured performance Visualization checks			
• Effectiveness Evaluation	- Measure the performance of the DIS in terms of how effective it is against the threat, how resources are used, and how efficient it is in operation	Face validation SME and domain experts			

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Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
7 6. Accreditation					
• Accreditation Team Support	- Accreditation Team is formed IAW individual agency/ customer requirements and policies - V&V Team briefs Accreditation Team with V&V data, results, procedures, tools, and methods - V&V Team remains available to answer questions and supply additional data when requested	SME and domain experts Full representation by team			
• Accuracy of Results	- Determine the accuracy and reasonableness of the results through analysis, comparison to other tests, and other appropriate evaluation techniques - Combine this activity with the following procedure when appropriate	Face validation Turing tests Visualization Test instruments			
• Expert Opinion	- Request the participation of experts in the domains and in M&S to ensure integrity of the configuration, reasonableness of the results, and sanity of the DIS exercise - Perform in-depth analysis of all deficiencies and attempt to pin-point the root causes	SME and domain experts			
• Overall Performance Assessment	- Much like the Validation Test Suite, Accreditation assesses the overall performance of the netted DIS, evaluates individual entity contributions, and examines the results versus the scenario to ensure that all objectives are met - When Accreditation occurs prior to including all live participants, these interfaces and interactions will be emulated in a realistic manner to represent typical loading and stimuli/response chains. Results will be confirmed during full-up live testing	Comprehensive performance and operational tests Scenario timeline Scripts Data recording and reduction Post-test analysis			

CN-49-10

VV&A Quick Planner ©

Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
7 ~~6~~. Accreditation (Continued)					
• Total System Level SME	- In conjunction with the overall performance assessment above, assemble a team of SME personnel to completely evaluate both the functional completeness and integrity of the DIS and its operation against the scenario	MOPs and MOEs Face validation Post-test analysis			
• Comparison to Real World	- In conjunction with the overall performance assessment and total system level SME, compare the performance, behavior, and operation of the DIS and its individual entities to the real world	Scientific theory and accepted algorithms Visualization			
	- Numerous questions relating to fidelity, realism, timing, actions and reactions, human in the loop, utilization of resources and materiel, communications, visualization, and environment will be addressed. Overall, the Accreditation Team must determine if the DIS is representative enough of the real world to be widely accepted by the DIS community.	Measures of phenomena Measured performance Turing tests Comparisons to other validated M&S			
• Stress/Boundary Tests	- As resources allow and using sensitivity and boundary test results from validation, confirm and evaluate the performance of the DIS in stressing situations. Observe and measure the degration of the overall DIS as various components and parts are stressed, disrupted, corrupted, disturbed, and/or jammed.	Stress tests Boundary tests Instrumentation			
	- At the same time, determine the realistic operational boundaries in which the netted DIS can still operate albeit in a degraded state.	Measured performance			

VV&A Quick Planner ©

Activity	Procedure	Tool/Method	Application		
			Rqd	Opt	N/A
1 ~~6~~. Accreditation (Continued) • Specific or Class Level Accreditation	- Determine the appropriate accreditation classification for the DIS based on the results of the 7 steps stated above and on the policies and procedures of the accrediting organization - If numerical classification is required, select and assign the appropriate value	Use appropriate service and agency guidelines			

1A.	DIS-Compliant Producer Data VV&C Verification	Run/review quality tests on data to ensure ranges, accuracies, scalar values, etc. are correct and within acceptable limits Ensure that data will run with DIS network without corruption Examine Producer Data VV&C history for incorporation into current User Data VV&C plans
1B.	DIS-Compliant Previous User Data VV&C Verification	Review previous User data for applicability Examine Previous User Data VV&C history for incorporation into current User Data VV&C plans

2A. Use Data Standards to determine data model for intended use

3.A	Review & Validate Appropriateness of Data for Model Purpose	Review/analyze metadata for each source for compatiblity with proposed model algorithms Determine availability of data

4.A	Design Data Algorithms	Determine details of each data transfer and message
		Develop/test data algorithms as necessary for Key algorithm analysis
		Determine impact on timing

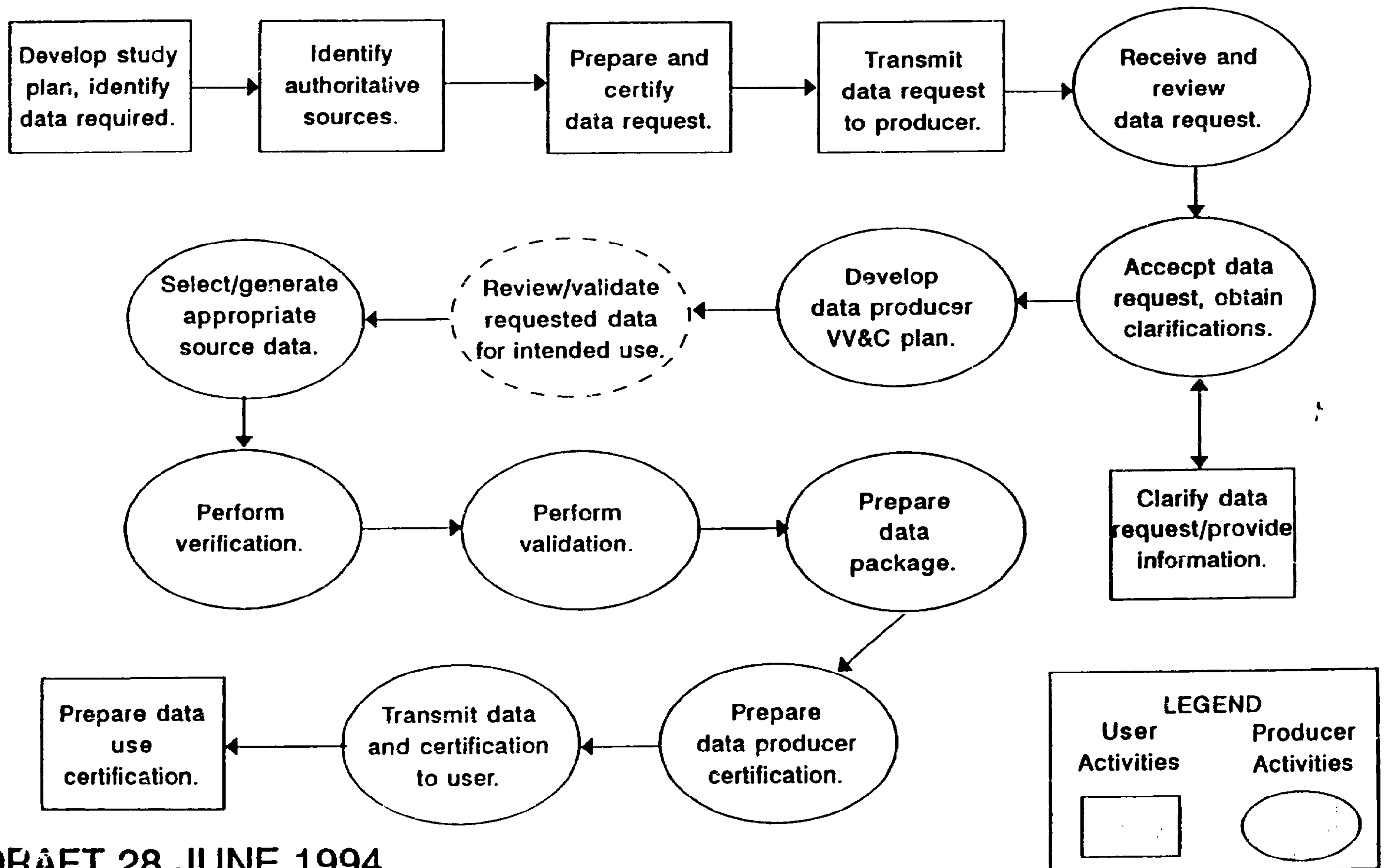
5.A	Verify & Implement Data Algorithms & Integrate Data	Verify the design of each interface including the DIS PDUs being used Verify that messages embedded in PDUs are handled correctly IAW with Data VV&C plans Confirm each data field, value and range If necessary develop a data test driver to simulate the network to ensure interoperability and correctness

6.A Validate, Certify & Produce Report	Calibrate the contribution of live components from data collected during live exercises for use in the test suite as default values for simulating them
	Perform real-world comparisons to data when possible
	Produce report of findings for repository and for use in accreditation

Mark Ralston ! Non-DIS Process (N)

DATA VV&C PROCESS

NON-DIS APPLICATIONS



DRAFT 28 JUNE 1994

DATA VV&C PROCESS GUIDELINES, NON-DIS APPLICATIONS		
ACTIVITY	PROCEDURE	TOOLS/METHOD
1. Develop study plan, identify data required. (Data User)	- Identify: Threats, Force Structure, Scenario, Time Frame, Geographic Area, Models, Study Milestones. - Determine: Materiel Systems, Variants, and Surrogates to be included in the study. - Specify: Categories/type of data required.	Study director and team working under the guidance of a Study Advisory Group (SAG).
2. Identify authoritative sources. (Data User)	- Determine: Internal/external availability of data. - Review: Policies/regulations for authoritative sources. - Specify: Authoritative sources for categories/type of data required.	Study team using published policies, guides, and Automated Data Repositories (ADRs) in coordination with data producers.
3. Prepare and certify data request. (Data User)	- Identify: Specific type, format, and range of data required. - Resolve: Data conflicts and inconsistencies. - Obtain: Data request certification if required.	Study director and other agencies as required by local policy or regulation.
4. Transmit data request to producer. (Data User)	- Determine: Media and method of data request transmission. - Transmit: Data request to authoritative source.	Study team using ADRs, data networks and other electronic media.

DATA VV&C PROCESS GUIDELINES, NON-DIS APPLICATIONS		
ACTIVITY	PROCEDURE	TOOLS/METHOD
5. Receive and review data request. (Data Producer)	- Obtain: Data request from data user. - Review: Data request to verify correct source, completeness of information in the request, and feasibility of milestones.	Data producer or data manager using ADRs and/or other DBMS to review request.
6. Accept data request, obtain clarifications. (Data Producer)	- Determine: Acceptability of data request. - Prepare: Questions, requests for additional information, indication of feasibility of meeting study milestones.	Data producer or data manager using Subject Matter Expert (SME) review.
7. Clarify data request/provide information. (Data User)	- Submit: Answers to questions from data producer, additional information on study.	Study director and team responding.
8. Develop data producer VV&C plan. (Data Producer)	- Determine: Method for searching, extracting, generating data; final format of data package; applicable process and data models; data standrds to be applied during verification; best source of comparison/benchmark data to be used in validation; resources and milestones.	Data producer or data manager following published data standards and procedures to produce written VV&C plan.

DATA VV&C PROCESS GUIDELINES, NON-DIS APPLICATIONS		
ACTIVITY	**PROCEDURE**	**TOOLS/METHOD**
9. Review/validate requested data for intended use. (Data Producer)	- Review: Models/applications that will use requested data. - Determine: Appropriateness of requested data for its intended use. - Notify: Data user of caveats and limitations on requested data and possible inappropriateness of requested data for intended use.	Data producer SME performing review of intended use of requested data.
10. Select/generate appropriate source data. (Data Producer)	- Determine: Technique for extracting or generating requested data. - Produce: Requested data in required format and range.	Data producer using ADRs, other DBMS, and models/ simulations to produce data.
11. Perform verification. (Data Producer)	- Use: Techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling.	Data producer using automated and manual methods.
12. Perform validation. (Data Producer)	- Determine: Through subject matter experts that the data produced represents the best available within stated criteria and assumptions and within time and resource constraints.	Data producer SME using automated and manual methods.
13. Prepare data package. (Data Producer)	- Produce: Complete package of requested data and appropriate meta-data in the format and media required by the data user.	Data producer using ADRs, other DBMS and manual methods.

DATA VV&C PROCESS GUIDELINES, NON-DIS APPLICATIONS		
ACTIVITY	PROCEDURE	TOOLS/METHOD
14. Prepare data producer certification. (Data Producer)	- Review: Completed data package. - Prepare: Data producer certification statement.	Data manager conducting senior level review and preparing written correspondence.
15. Transmit data and certification to user. (Data Producer)	- Send: Data package and certification statement to data user in requested format, media, and transmission means.	Data producer using ADRs, data networks and other electronic media.
16. Prepare data use certification. (Data User)	- Review: Data package and producer certification. - Prepare: Statement indicating that data are appropriate for the study and were used correctly.	Study director conducting senior level review and preparing written correspondence.

VVC M

JTAMS OVERVIEW

Presentation to Data Standards / VV&C Task Force

by

Lt. Col. Rick Barker, USAF

14-15 July 1994

OSD / JTAMS 1441 Stewart St., Lackland AFB, TX 78236
(210) 671 - 1905 DSN 473 - 1905 FAX (2459)
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PURPOSE

- Provide summary information about the Joint Tactical Missile Signatures (JTAMS) Program
- Gain Insight For Potential Pilot VV&C Implementation

Overview

- Background
- Program Outline
- Library Development

BACKGROUND

THREAT

- **Increasingly Sophisticated and Passive**
  - 90% Aircraft Losses Since '67 War
  - Growing Surface Threat to Fleet and Vehicles
- **Cheap, Effective, Widely Owned**
- **Detailed Signature Data Required for new Warning Systems**

HISTORY

- AF Electronic Warfare Center Maintains Extensive Signature Data
  - Predominantly RCS and IR
  - 1988 Study of MWS Developers' Needs
  - Available Information Inadequate
- Feasibility Study Recommended by JT&E SAC-Oct 91
- Chartered as JTF -Nov 92

REQUIREMENTS SURVEY

- Detailed Technical Questionnaire
  - Sent to 60 DoD and Industry Groups
  - Searched 27 Existing Data Archives
- Responses from all Services/Disciplines
  - Operations
  - Intelligence
  - Research and Development
  - Acquisition
- 34 Missile Types Tested
  - 18 Prioritized as NEEDS
  - 51% of Testing Appeared Repetitive

PROBLEM

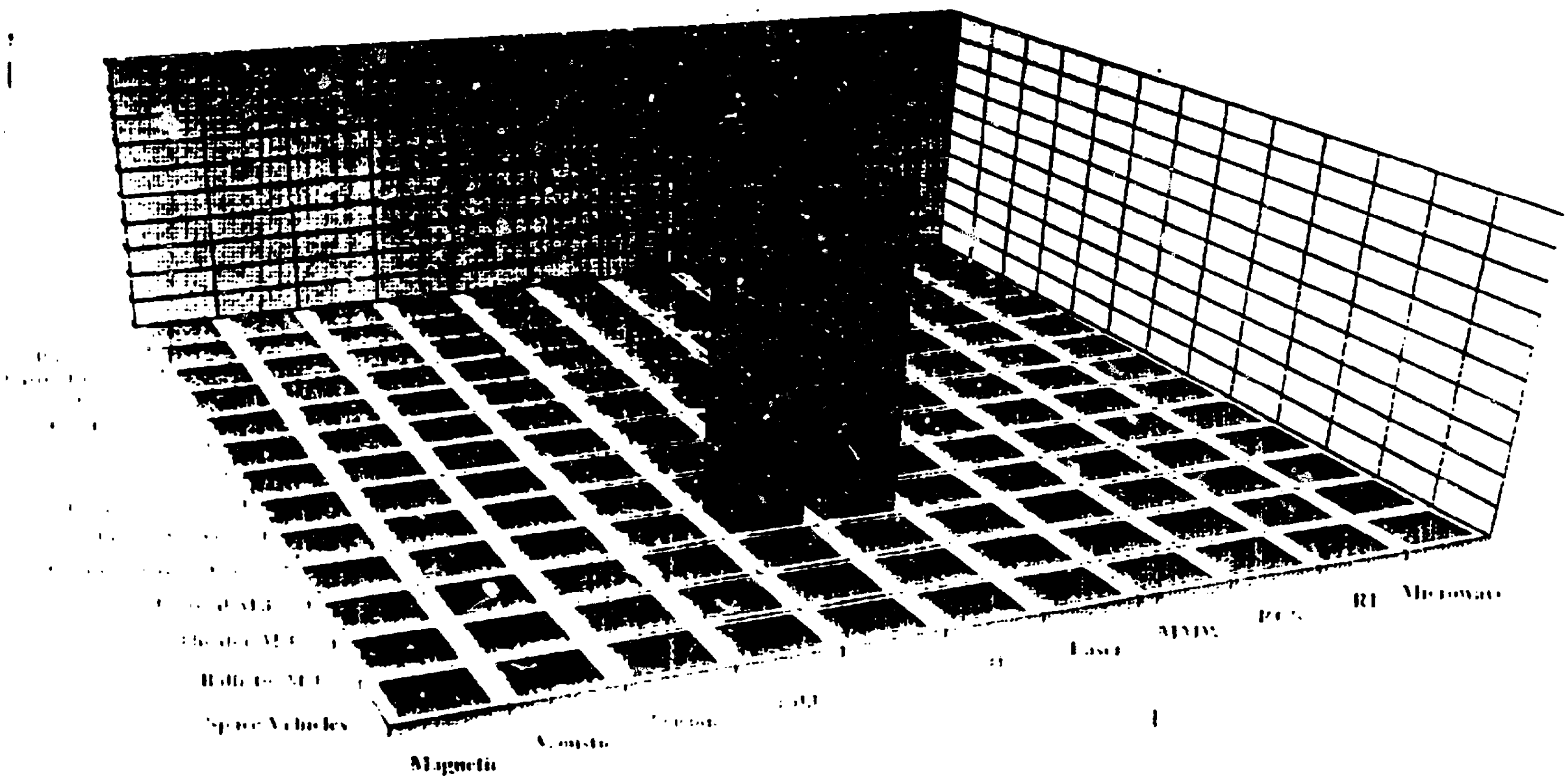
- TMS Community Efforts Uncoordinated
  - Lack of Standards
  - Duplication of Tests-51%
    - » One System Tested 16 Times
- Data Not Practical for General Use
  - Not Transferable
  - Difficult to Access
  - Poorly Documented

JTAMS SOLUTION

- Create Standards (Handbook)
  - Description
  - Procedures
- Create Joint Data Library
  - AFIWC Host
  - JEWC as Executive Agency
- Verify with Testing

PROGRAM OUTLINE

Signature Universe
JTAMS' Role



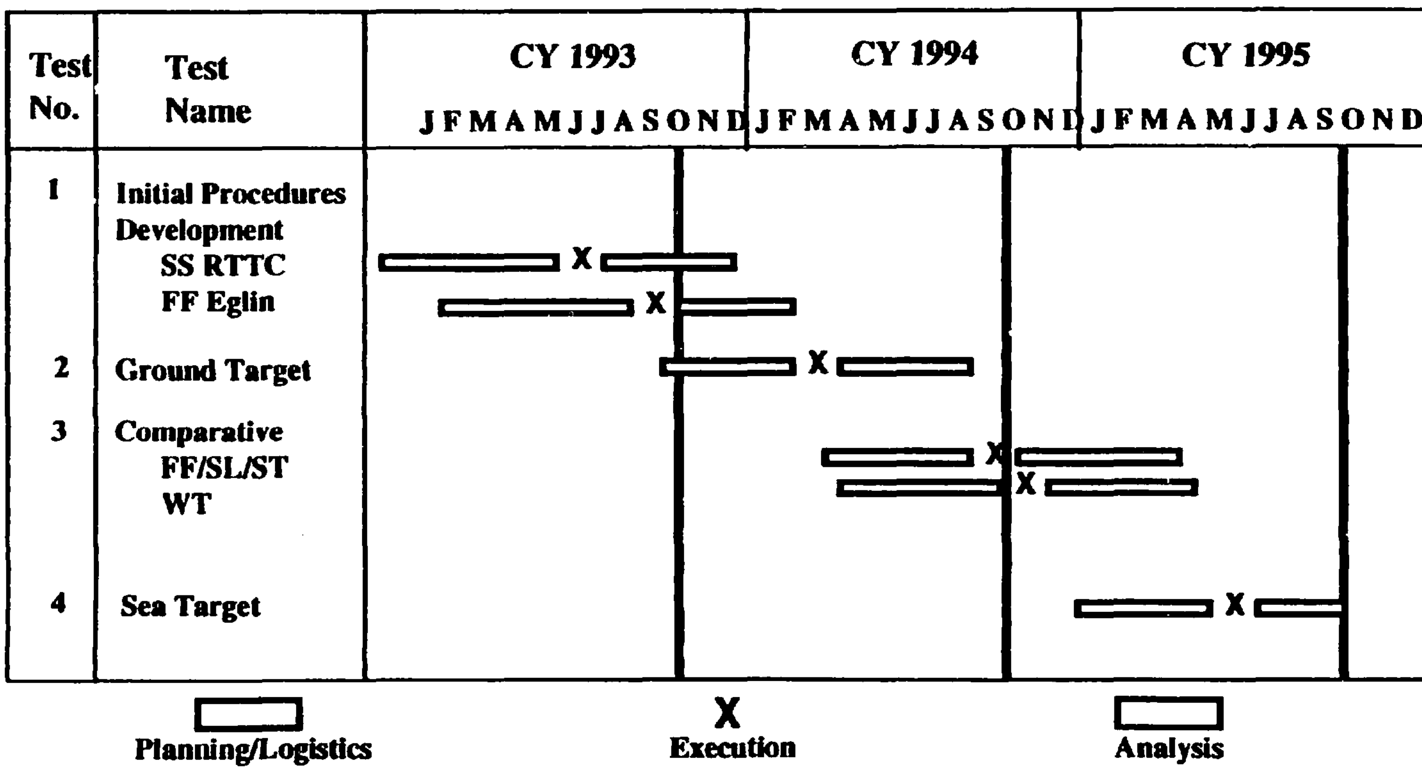
JTAMS

- 3 Year, $25M, OSD Chartered JTF
  - OUSD(A&T)/T&E(A&SP)
  - AF Lead, Tri-Service Effort
- Tactical Missile--
  - Small Tube, Line of Sight, Immediate Battlefield
  - Threat to a Single Tactical Asset-Ship, Plane, Tank
- IR (MWIR, SWIR, LWIR) & UV Top Priority
  - RCS & RF Well Understood
  - Passive IR & UV Emerging Threat Technologies

PROGRAM OBJECTIVES

- Develop Joint Standards for Describing Tactical Missile Signatures (TMS)
- Develop Joint Standard Procedures for Acquiring TMS
- Develop a Joint Interactive Data Library to Promote the Continued Acquisition and Dissemination of TMS
- Develop a Plan to Provide for Formalized DoD Implementation of TMS Standards and to Ensure Future Utilization of the Data Library by all the Services

Program Test Schedule



COMMUNITY SUPPORT

- MSIC, FASTC-Test Assets and Info
- MICOM, IDA, Pt MUGU-Phenomenology Models
- PDC, PL-FISTA, AEDC-Data Reduction and Format
- AEDC, ARL, 46th TW, FISTA-Test Measurements
- AFIWC, DIA (ARGUS)-Data Base Development
- F-22, Band IV CM, RSG-18-Test Management

JTAMS PRODUCTS

- **Objectives Lead Directly to Products**
  - OBJECTIVE 1===Standardized TMS Descriptors
    - » Transfer Format, Data Element Definitions, Fidelity
  - OBJECTIVE 2===DoD Handbook
    - » Two-Tiered Users Handbook-
      - Overview and General Information for the Manager
      - Specific Tools to Meet the Standards for Practicing Engineers
  - OBJECTIVE 3===Data Archive/Library
    - » Actively Managed Data Center
    - » On-Line Experimental and Modelled Data
    - » Requirements Tracking System
  - OBJECTIVE 4===Legacy Implementation Plan
    - » Designated Legacy Manager
    - » All Products In Place

CUSTOMER ID

- Data Library
  - Developers of Surveillance, Detection, and Countermeasures Systems
  - Operators Developing Doctrine and Tactics
  - System Developers Improving (Blue) System Effectiveness/Survivability
  - Modelers, Testers, Intel Players who Support the above
- Handbook Users
  - Gov't. Program Managers Tasked with the above
  - Test Directors and Engineers Tasked with the above
  - Modelers and Intelligence Support to the above

JTAMS BENEFITS

- Measurement Community Improvements
  - Areas for Future Investment Identified
  - Technical Improvements During JTAMS Tests
  - Measurement Process Improvement
- High Quality Data to Acquisition Process
  - Participants During Field Tests-
    - » F-22 MLD and NAVY AAR-47
    - » LORAL and WESTINGHOUSE MAWS Competitors
- Improvements in Data Archiving
  - Library Connects Users with Similar Requirements
  - ELIMINATE DUPLICATE TESTS
- Model Improvements
  - High Quality Data to improve such Models as SIRRM and SPF

LIBRARY DEVELOPMENT

LIBRARY ATTRIBUTES

- Maximize Use of Available TMS Data
  - Load, Manage, and Output TMS Data
  - Serve as a Center of Excellence for TMS
  - Technical Expertise on hand
  - Accessible to all Customers
- Requirements Tracking System
  - Open Requirements Tracked and Coordinated
  - Promotes Efficiencies in Testing

LIBRARY DEVELOPMENT

- ORACLE Based, Relational Data Base
  - Compatible with Current AFIWC Data Base
  - Transfer Format same as AFIWC existing
    - » Data in Level 2 Experiment Units (not Raw Measurements)
    - » Capable of Immediate Input to Various Models
- Intend to be First on ARGUS
- Consistent Support From AFIWC
  - Committed to Support JTF Solution
    - » Resources expended
    - » Some Personnel in place
  - Close Working Relationship with JTF
    - » Parallel Hardware Definition/Purchase
    - » JTF Data Base Personnel from AFEWC

JESEBEL

Joint Electromagnetic Signatures & Effects dataBasE Library

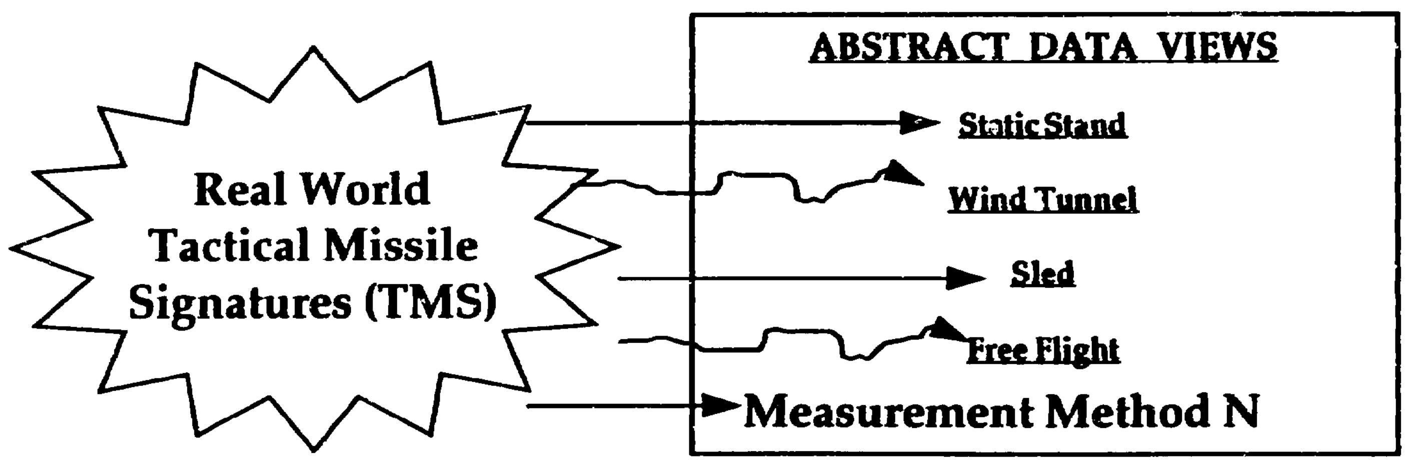
- **Complete Signature Data Management**
  - Aircraft (BATS) Compatible-IR/UV, RCS, RF
  - Tactical Missiles-IR/UV first, other spectra later
- **Modular Design Methodology**
  - DoD 2167-A
  - Complies w/JCS & Air Staff Memorandums
    - » JCSM 187-84
    - » PMD 0943(2)

JESEBEL MILESTONES

- 15 Sep 93- Requirements Document
- 15 Oct 93- Functional Description Document
- 25 Mar 94- Design Document
- 15 Aug 94- JESEBEL 1.0 Release
- 15 Oct 94- Populate w/JTAMS Data
- 1 Apr 95- Host @ AFIWC
- Continue BETA Versions

Background -- JTAMS data is?

- The result of {data} *modeling* of the real world TMS -- tactical missile source signature
  - In terms of infrared and ultraviolet emanations of motor plume
  - Data requirements also include metadata (ancillary data)
  - Several measurement methods - each an abstract "view"



Data Quality Implications

- No such thing as "best" data
  - best/correctness/completeness always relative to a particular purpose - i.e. modeling
  - "quality" of data means its suitability for some use
  - therefore, it is useful to think data quality as:
    - » suitability for a particular "customer's" purpose
- Cost-benefit analysis necessary to decide how much
  - Data V&V is worth doing
  - Model V&V is worth doing
- JESEBEL - a representation of abstract TMS
  - many alternative representations are possible
    - » corresponding to different data models/formats
    - » but every representation is a model of an abstract data view of the real TMS

How does JTAMS Promote TMS Quality?

- By recording sufficient metadata about TMS
  - To allow interpreting & evaluating the quality of the TMS
  - Transforming & propagating this metadata as necessary

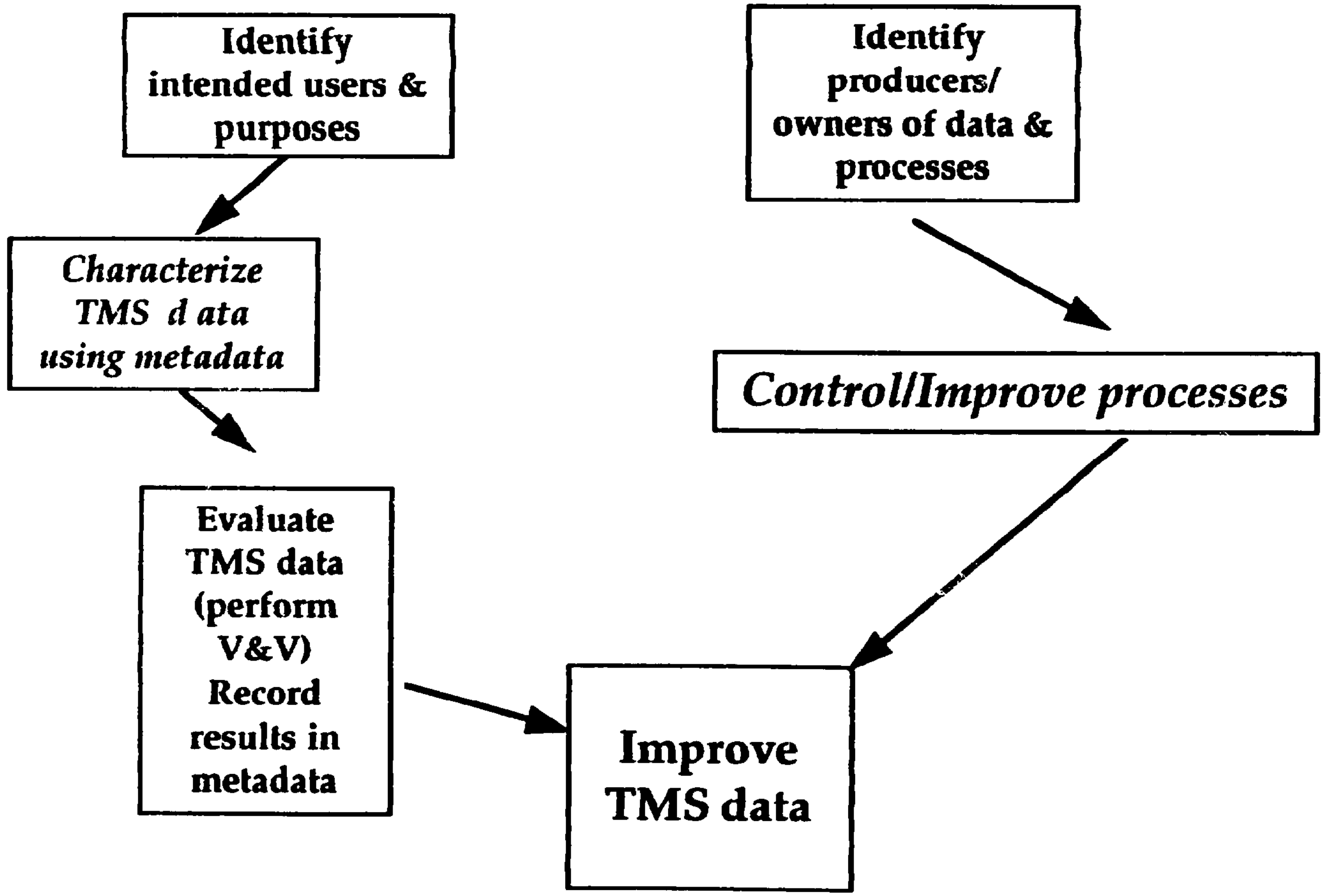
- By controlling / improving the processes that affect TMS
  - Measurement, data management and reduction, data analysis, modeling, archival, and distribution
  - Processes that generate, modify, and propagate TMS

How does JTAMS Promote TMS Quality? (cont.)

- By performing "producer" and "consumer" VV&C in terms of its metadata which specifies its intended users and purpose
  - Data requirements lists allow flexibility
  - Range of purposes served

- Recording the TMS evaluation results in additional metadata
  - Written quicklook reports and published test reports
  - Expert Panel review conferences and documenting meeting summary results

Framework for Providing Quality TMS



Data VV & C Process for JTAMS (cont.)

- **Certification**
  - "Authoritative" V & V, recorded with appropriate metadata
  - Link to usage: who, why, and what V & V technique for each use

- **Priortize VV & C**
  - For each data element or group of data elements (entire abstract data view)
  - Based on sensitivity analysis, if possible

- **Cannot be complete w/o implementing pilot study**
  - Incorporates use or purpose of data collected

Data VV & C Process for JTAMS

- Verification
  - Enforce appropriate calibration checks & report consistency statistics on instrument measurements
  - Indpendent of use or purpose
  - Propagate results back to data source (instrument operator)
  - All verification done on site -- provides ability to recoup

- Validation (objective + appropriateness)
  - Of data collection / manipulative (reduction) processes
  - Of data with respect to the real TMS it describes (expert panel review)
  - Propagate results back to data maintainer (DB archive) and data source (instrumentation / calibration procedures)
  - Appropriateness depends on user purpose (study-specific)

JTAMS Data Process Improvement Steps

- Established process owner & Mgt teams
  - Team members from each "functional area"
- Described process qualitatively
  - Identified customers and suppliers, activity sequence, information flow
  - Mapped customer requirements to roles of everyone involved in the process
- Establishing a measurement system
  - Measuring only few, most relevant items
  - Continuously evolving and improving measures
- Establishing control over TMS processes
  - Check conformance to requirements (i.e., cross-calibration)

JTAMS Data Process Improvement Steps

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JTAMS Data Process Improvement Steps (cont.)

- Identified and selected improvement opportunities
  - Priortize and define focused improvement projects (i.e. RTTC static stand construction)
  - Adjusting calibration philosophy
- Making & sustaining improvements
  - Provide resources & direction (DoD Handbook & Organizational implemenation of DoD Legacy Plan)

JTAMS Actions Affecting TMS Data Quality

- Identified relevant processes throught data life-cycle
  - Measurement/Creation, modification, maintenance, transformation, propagation
  - Extrapolation (comparing / combining empirical with simulated data sets)
- Identified "owners" of data and processes
  - Ownership must be "taken" - not assigned
  - An owner must take responsibility and have capability, willingness, recognized authority, resources
- Empowered/facilitated/supported process control and improvement
  - Obtained consensus among stakeholders via event execution and expert panel reviews
  - Developed and documented appropriate techniques (Handbook)

7 APR 93

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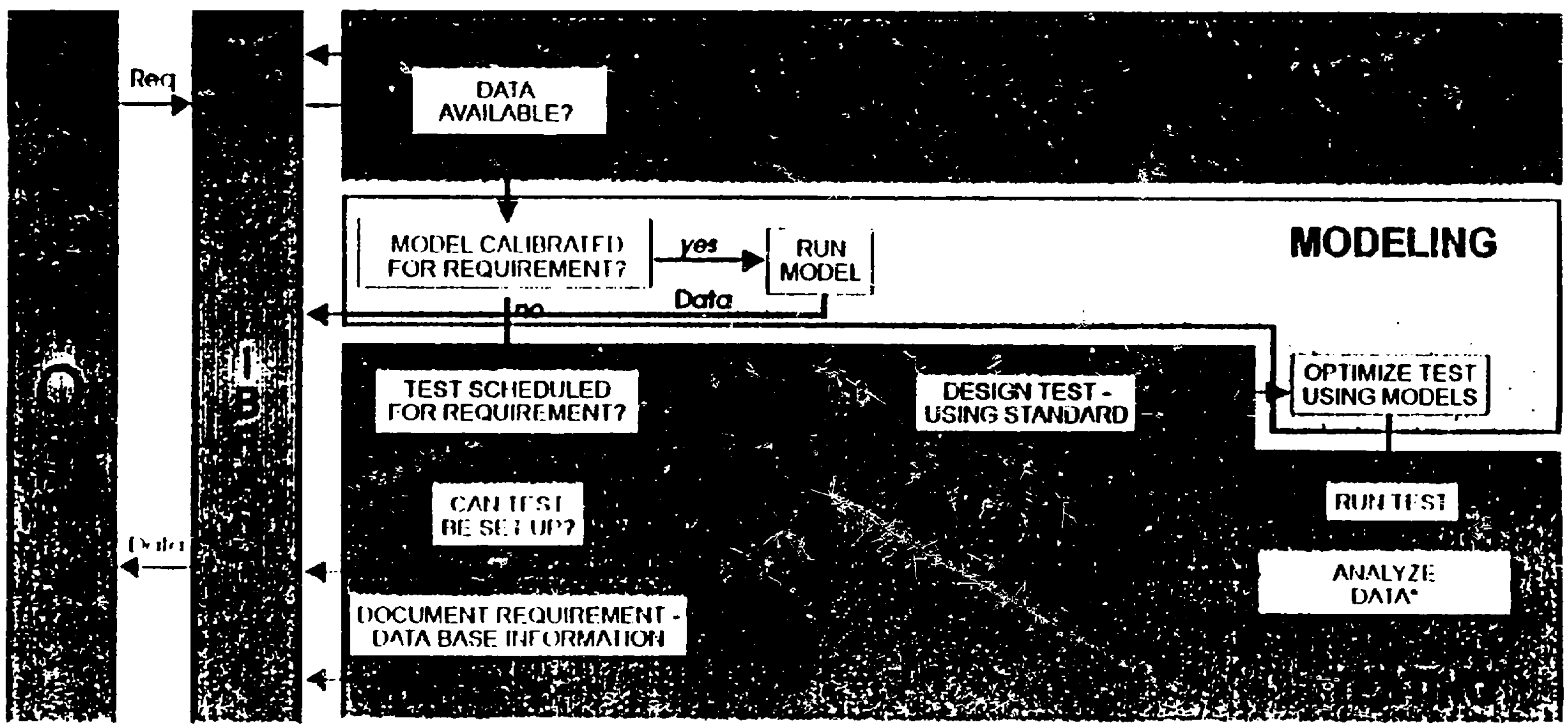
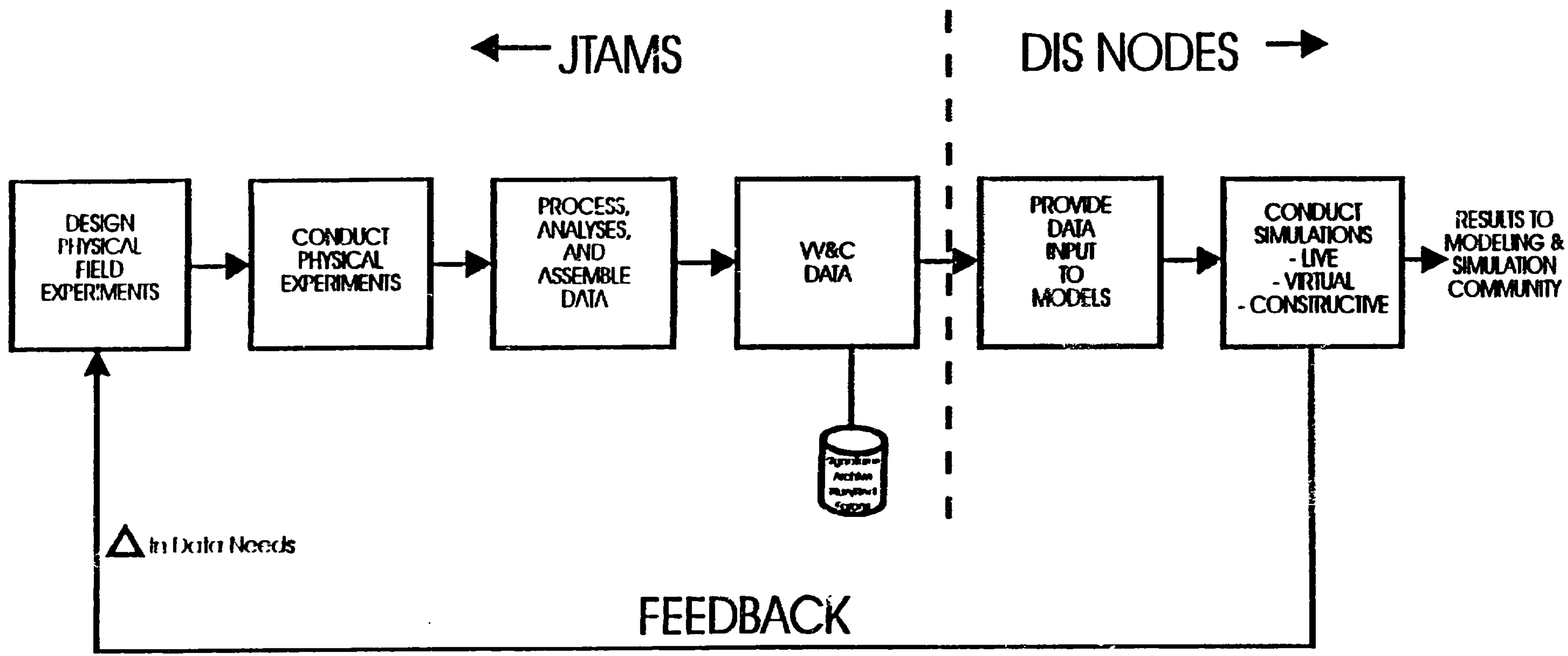
LEGACY



* DATA ALSO FEEDS BACK FOR MODEL CHARACTERIZATION

STANDARDS AND PROCEDURES PERIODICALLY UPDATED

THE JTAMS TRAIN
(ALSO REPRESENTS THE GENERAL CASE)



WE CALL THIS
- THE SCIENTIFIC METHOD
- CONTROL THEORY

83774A.CDR

Summary of IEEE Metadata Workshop

Held at National Archives II

(5/16-18/94)

Focused on Scientific Data & Metadata Needs

- Need to share data across disciplines and contexts
  - Requires the ability to translate terminology, units, scales, etc.
  - Must be able to access virtual, composite datasets (semantic "joins")
  - Must be able to propagate and translate assumptions
- Data may appear different across disciplines or contexts
  - Not just different names, but different "cuts" or semantic interpretations
  - Data may be used for unintended purposes
- Scientific data may have special characteristics
  - Generated by "instruments" with particular calibration attributes
  - Collected during specific "experiments" or "expeditions"
  - Many datasets are huge
- Try to produce a "reference model"
  - Providing a framework for scientific metadata
  - To support access & [semi-] automated machine translation

Metadata should be machine-interpretable

- Metadata should allow systems to help users
  - Access data (by interpreting queries)
  - Translate data (by transforming units, scales, etc.)
  - Construct virtual, composite datasets

- A standard representation is highly desireable
  - To model many disciplines & contexts in a uniform way
  - To allow translating each context into (or from) the standard
  - To allow 2n translators to do the work of n^2

- But metadata should be human-readable as well
  - For cases where automated translation is inadequate
  - To facilitate V&V

Many aspects of data must be represented

- Non-scientific domains should (ideally) be supported as well
  - Business/commercial databases
  - Military databases
  - Other

- Non-scientific attributes of data must also be supported
  - Administrative/business concerns (ownership, privacy, costs)
  - Quality concerns (usage & transformation history, audit trails, etc.)

- Metadata serves many needs
  - Different kinds of users (scientists, scholars, decisionmakers)
  - Coming from different disciplines (science, statistics, policy analysis)
  - Serving different roles (research, administration, education)
  - Performing different tasks (generation, access, maintenance, analysis)

Begin by modeling

- Find a suitable modeling formalism
  - Capable of representing disciplines, users, roles, tasks, domains
  - Capable of representing processes as well as static relationships
  - Machine-interpretable as well as human-readable

- Several candidate formalisms were suggested
  - Petrotechnical Open Software Corporation (POSC) tools EXPRESS
  - ISO's predicate logic-based Knowledge Interchange Format (KIF)
  - The ADAMS programming language

- Apply the chosen formalism to a number of contexts
  - Model entire information enterprises: users, tasks, roles, etc.
  - Generalize from a number of such examples in different domains
  - Produce a (fairly) general model of what users do with data
  - Attempt to derive a general-purpose metadata model from this

DoD 8320.1-M-3

DEPARTMENT OF DEFENSE

DATA QUALITY ASSURANCE PROCEDURES
(DRAFT)

"Quality Information for a Strong Defense"

February 1994

Office of the Assistant Secretary of Defense
(Command, Control, Communications, and Intelligence)

FOREWORD

This Manual is issued under the authority of DoD Directive 8320.1, "Department of Defense Data Administration," September 26, 1991. It provides procedural guidance for DoD Data Quality Assurance as established by DoD 8320.1-M, "Data Administration Procedures," September 23, 1993 (DRAFT).

This Manual applies to the Office of the Secretary of Defense (OSD); and to the Military Departments (including the National Guard and Reserve Components), the Chairman of the Joint Chiefs of Staff (CJCS) and the Joint Staff, the Unified and Specified Combatant Commands, the Inspector General of the Department of Defense, the Defense Agencies, and the DoD Field Activities (hereafter referred to collectively as the "DoD Components"). Its provisions are applicable to all new initiatives to develop, modernize, or migrate information systems, whether automated, or non-automated.

This Manual is effective immediately; it is mandatory for use by the OSD and all the DoD Components.

Send recommended changes to the Manual to:

Defense Information Systems Agency
Joint Interoperability and Engineering Organization
Center for Information Management/XD
Data Administration Program Management Office
701 S. Courthouse Road
Arlington, VA 22204-2199

The OSD and the DoD Components may obtain copies of this Manual through their own publications channels. Defense contractors and other Federal Agencies may obtain copies from:

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- NAME -

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REFERENCES

(a) DoD Directive 8320.1, "DoD Data Administration," September 26, 1991

(b) DoD Directive 8000.1, "Defense Information Management (IM) Program," April 14, 1992

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(t) "Corporate Information Management, Process Improvement Methodology For DoD Functional Managers," Second Edition, Revised and Expanded, D. Appleton Company, Inc., 1993

(u) NCSC-TG-004, "Glossary of Computer Security Terms," October 21, 1988

(v) NBS Special Publication 500-152, "Guide to Information Resource Dictionary Systems Applications: General Concepts and Strategic Systems Planning," April 1988

(w) NBS Special Publication 500-149, "Guide on Data Entity Naming Conventions," October 1987

(x) DoD Directive 5200.28, "Security Requirements for Automated Information Systems," March 21, 1988

DEFINITIONS

1. Accessibility. The ease to approach, enter, or to obtain. (reference (g))

2. Accuracy. Correct data that conforms to models derived to support enterprise requirements and standards. (reference (d))

3. Adherence to standards. TO BE DETERMINED.

4. Amount of historic data. TO BE DETERMINED.

5. "As is" activity/data model. Activity/data model that portrays how a business process in currently structured. It is used to establish a baseline for subsequent functional process improvement activities or programs. See modeling. (reference (d))

6. Authorization. The rights granted to a user to access, read, modify, insert, or delete certain data, or to execute certain programs. (reference (e))

7. Automated Information System (AIS). A combination of computer hardware and computer software, data and/or telecommunications, that performs functions such as collecting, processing, storing, transmitting, and displaying information. Excluded are computer resources, both hardware and software, that are: physically part of, dedicated to, or essential in real time to the mission performance of weapon systems; used for weapon system specialized training, simulation, diagnostic test and maintenance, or calibration; or used for research and development of weapon systems. (reference (d)) (Modified from DoDD 8120.1)

8. Availability. The state when data are in the place needed by the user, at the time the user needs them, and in the form necessary by the user. (reference (u))

9. Believability. To have faith or confidence. The extent to which accept as true or real. (reference (g))

10. Completeness. The quality of maintaining data which satisfies all demands or requirements. (reference (d))

11. Confidentiality. The concept of holding sensitive data in confidence, limited to an appropriate set of individuals or organizations. (reference (u))

12. Consistency. Data is maintained so that it is free from variation or contradiction. (reference (d))

13. Correctness. Free from error or fault; true or accurate. Conforming to standards; proper. (reference (g))

14. Currency. Currency is a measure of the degree to which specified values are up-to-date. (reference (h))

15. Data. A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means. (reference (e))

16. Data Administration (DAdm). The responsibility for definition, organization, supervision, and protection of data within an enterprise or organization. (reference (a))

17. Data Administrator (DAd). A person or group that ensures the utility of data used within an organization by defining data policies and standards, planning for the efficient use of data, coordinating data structures among organizational components, performing logical database designs, and defining data security procedures. (reference (v))

18. Data Element. A named identifier of each of the entities and their attributes that are represented in a database. (reference (e))

19. Data Element Standardization. The process of documenting, reviewing, and approving unique names, definitions, characteristics and representations of data according to established procedures and conventions. (reference (k))

20. Data Element Standardization Life Cycle. Generic elements and standard data elements evolve through one or more phases of a data element life cycle. The five phases of the generic element or standard data element life cycle are developmental, candidate, approved, modified, and archived. (reference (k))

21. Data Entity. An object of interest to the organization, usually tracked by an automated system. (reference (w))

22. Data Integrity. The state that exists when data is handled as intended and is not exposed to accidental or malicious modification, destruction, or disclosure. (reference (e)) In information processing, the condition in which data is accurate, current, consistent, and complete. (reference (v))

23. Data Model. In a database, the user's logical view of the data in contrast to the physically stored data, or storage structure. A description of the organization of data in a manner that reflects the information structure of an enterprise. (reference (e))

24. Data Quality. The correctness, timeliness, accuracy, completeness, relevance, and accessibility that make data appropriate for use. (reference (e))

25. Data Repository. A specialized database containing information about data, such as meaning, relationships to other data, origin, usage, and format, including the information resources needed by an organization. (reference (d))

26. Data Steward. The person or group that manages the development, approval, and use of data within a specified Functional Area, ensuring that it can be used to satisfy data requirements throughout the organization. (reference (k))

27. Data Synchronization. The timing requirements of a data element, or between/among data elements. (reference (d))

28. Database. A collection of interrelated data, often with controlled redundancy, organized according to a schema to serve one or more applications; the data are stored so that they can be used by different programs without concern for the data structure or organization. A common approach is used to add new data and to modify and retrieve existing data. (reference (e))

29. Database Administration (DBAdm). The activity responsible for the enforcement of the policies and standards established by the DAd, to include providing technical support for physical database definition, design, implementation, maintenance, integrity, and security; and coordinating with computer operations technicians, system developers, vendors, and users. DBAdm is oriented toward technical support for databases and the effective and efficient use of information technology resources. (reference (d))

30. Database Administrator (DBAd). A person or group which provides technical support for one or more databases, by defining database schemas and subschemas, by maintaining data integrity and concurrency, providing physical database design for performance optimization, and enforcing the policies, standards, and procedures set by the DAd. (reference (v))

31. Extensibility. The capability to create new functionality in data/information system. (reference (e))

32. Flexibility. Adaptability. Responsiveness to change. (reference (g)) (Also see "modularity").

33. Functional Process. A well-defined (or definable) set of logically related tasks and decisions within a functional activity that use resources to produce products or services. (reference (d))

34. Functional Process Improvement (FPI). Application of a structured methodology to define a function's "as is" and "to be" environments; current and future mission needs and end user requirements; objectives and a strategy for achieving those objectives; and a program of incremental and evolutionary improvements to processes, data, and supporting AISs that are implemented through functional, technical, and economic analysis and decision-making. (reference (q))

35. Information. Any communication or reception of knowledge such as facts, data, or opinions, including numerical, graphic, or narrative forms, whether oral or maintained in any medium, including computerized databases, paper, microform, or magnetic tape. (reference (b))

36. Information Systems (IS). The organized collection, processing, maintenance, transmission, and dissemination of information, in accordance with defined procedures, whether automated or manual. (reference (x)) (As modified by OMB Cir A-130)

37. Interpretability. The ability to represent or render the meaning of. The ability to extract an explanation. (reference (g))

38. Logical Data Model. A model of data which represents the inherent structure of that data and is independent of individual applications of the data and also of the software or hardware mechanisms which are employed in representing and using the data. (reference (d))

39. Metadata. Information describing the characteristics of data; data or information about data; descriptive information about an organization's data, data activities, systems, and holdings. (reference (v))

40. Metric. A process of algorithm that may involve statistical sampling, mathematical computations, and rule-based inferencing. Metrics provide the capability to detect and report defects within a sample (reference (n))

41. Migration System. An existing AIS, or a planned and approved AIS, that has been officially designated to support standard processes for a functional activity applicable DoD-wide or Component-wide. (reference (d)) (DoDD 8120.1)

42. Modeling. Application of a standard, rigorous, structured methodology to create and validate a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process. Process improvement modeling defines and documents the current ("as is") and desired future ("to be") processes and information requirements of a functional activity. (reference (d))

43. Modularity. The extent to which a system is composed of modules. (reference (e)). Designed with standardized units or dimensions for flexible use. (reference (g)) (Also see "flexibility").

44. Physical Data Model. A representation of the technologically independent information requirements in a physical environment of hardware, software, and network configurations representing them in the constraints of an existing physical environment. (reference (e))

45. Precision. A measure of the ability to distinguish between nearly equal values; for example, four-place numerals are less precise than six-place numerals; nevertheless, a properly computed four-place numeral may be more accurate than an improperly computed six-place numeral. (reference (e))

46. Program Administration. The management activity necessary to manage a program across functional and organizational areas. (reference (d))

47. Quality Assurance (QA). The policies, procedures and systematic actions established in an enterprise for the purpose of providing and maintaining some degree of confidence in data integrity and accuracy throughout the life cycle of the data. The planned systematic activities necessary to ensure that a component, module, or system conforms to established technical requirements. (reference (e))

48. Relatability. The quality of data that permits it to be rationally correlated or compared with other similar or like data. (reference (d))

49. Relevance/Relevancy. The state of maintaining data in a condition that provides the ability to retrieve the specific information needed by the user. (reference (d))

50. Reliability. The extent to which can be relied upon; dependability. (reference (g))

51. Schema. A description, or global model, of the structure of a database. (reference (e))

52. Single Point-of-Entry. The organization(s) responsible for entering data values for a data element. (reference (d))

53. Stability. Constancy of character or purpose; steadfastness. Reliability; dependability. (reference (g))

54. Technical Infrastructure. The internal framework that must be built to implement an operational service. (reference (d))

55. Timeliness. A condition which requires that a data item or multiple items are provided at the time required or specified. (reference (d))

56. "To Be" Activity/Data Model. Activity/data models that result from a functional process improvement action or program. The "to-be" model shows how the business process will function and the data it will use after the improvement action is implemented. See modeling. (reference (d))

57. Traceability. To ascertain the successive stages in the development or progress of. To have origins; be traceable. (reference (g))

58. Unit of Measure. TO BE DETERMINED.

59. Uniqueness. The state of being the only one of its kind; sole. Being without an equal or equivalent; unparalleled. (reference (g))

60. Validity. The quality of maintained data that is found on an adequate system of classification (e.g., data model) which is rigorous enough to compel acceptance. (reference (d))

ABBREVIATIONS AND/OR ACRONYMS

AIS	Automated Information System
AIS PM	Automated Information System Program Manager
ASD (C3I)	Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
CDAd	Component Data Administrator
CIM	Center for Information Management
CJCS	Chairman, Joint Chiefs of Staff
DAd	Data Administrator
DAdm	Data Administration
DAPM	Data Administration Program Manager
DAPMO	Data Administration Program Management Office
DASD (IM)	Deputy Assistant Secretary of Defense for Information Management
DASP	Data Administration Strategic Plan
DBAd	Database Administrator
DBAdm	Database Administration
DBMS	Database Management System
DDI	Director for Defense Information
DDI (FIM)	Director for Defense Information, Functional Information Manager
DDRS	Defense Data Repository System

DISA	Defense Information Systems Agency
DoD	Department of Defense
DoD DAd	DoD Data Administrator
DQE	Data Quality Engineering
DTR	Data Trouble Report
FAPM	Functional Activity Program Manager
FDAd	Functional Data Administrator
FIM	Functional Information Manager
FIPS	Federal Information Processing Standards
FPI	Functional Process Improvement
IDEF	Integrated Computer-Aided Manufacturing Design
IM	Information Management
IS	Information System
OSD	Office of the Secretary of Defense
OSD PSA	Office of the Secretary of Defense, Principal Staff Assistant
NBS	National Bureau of Standards
NGT	Nominal Group Technique
PM	Program Manager
PQC	Poor-Quality Cost
QA	Quality Assurance

QFD	Quality Function Deployment
TDQM	Total Data Quality Management
TQM	Total Quality Management

CHAPTER 1

GENERAL INFORMATION

A. INTRODUCTION

1. This Manual provides procedures for implementation of the policies and concepts set forth in DoD Directive 8320.1, "DoD Data Administration" (reference (a)). This Manual supports the DoD Directive 8000.1, "Defense Information Management (IM) Program" (reference (b)). It is one in a series of manuals which describe DoD data administration (DoD DAdm) procedures. This Manual specifically addresses DoD Data Quality Assurance Procedures. Data are principal DoD resources, and having accurate, quality data is critical to the military. Within DoD, satisfying the data requirements of the warfighters and the business areas is essential. This Manual provides the framework for improving and ensuring the quality of DoD data.

2. The mission of DoD DAdm is "to provide for effective and economic acquisition, dissemination, and use of data to enhance performance and integration of operations" as documented in the DoD Data Administration Strategic Plan (DASP) (reference (c)).

a. The DoD Data Administration Program mission concentrates on six (6) major DAdm goals. Each goal is a broad statement of long-term priority objectives for DoD DAdm. These six (6) goals are to: (1) Support the Operational Central Repository, (2) Establish Standard Data, (3) Expand Use of Common Pro... s and Tools, (4) Establish Data Quality and Data Security Process, (5) Expand Edu... ing, and Consultation Services, and (6) Develop an Effective Data Administratio... These goals focus on benefits necessary to realize the future vision of DoD DAd... r-, mid-, and long-term objectives for the DoD DAdm Program are document... in the DoD Data Administration Strategic Plan (DASP) (reference (c)).

b. Goal No. 4: Establish Data Quality and Data Security Process. A data quality assurance and data security program ensures that DoD operations and decision making are supported with data meeting needs of availability, accuracy, timeliness, integrity, and need-to-know requirements (reference (c)). One of the guiding principles of DoD DAdm is to ensure that data products will be managed throughout the life cycles to improve business methods, efficiency of operations, and the quality of data. DoD personnel will use quality data for

planning and analysis; as a result, decision making will be improved. This Manual supports the DoD DAdm goal to establish DoD Data Quality Assurance Procedures.

B. PURPOSE

To provide the highest quality data to the DoD data/information community, this Manual identifies quality assurance issues and provides guidance for DoD implementation. Also, this Manual provides detailed procedures for the specific DAdm activity of data quality assurance. Figure 1-1 illustrates the relationship of this Manual (8320.1-M-3) to the DoD Data Administration policy directive, (DoDD 8320.1, reference (a)), and the overall DoD Data Administration Procedures (DoD 8320.1-M, reference (d)).

C. SCOPE AND APPLICABILITY

The scope and applicability of this Manual are identical with the Scope and Applicability statements of DoDD 8320.1 (reference (a)).

D. OBJECTIVES

It is the intent of DoD DAdm that the implementation of these procedures will lead to useful, suitable, available and accessible information to enable the successful execution of the missions of the Department.

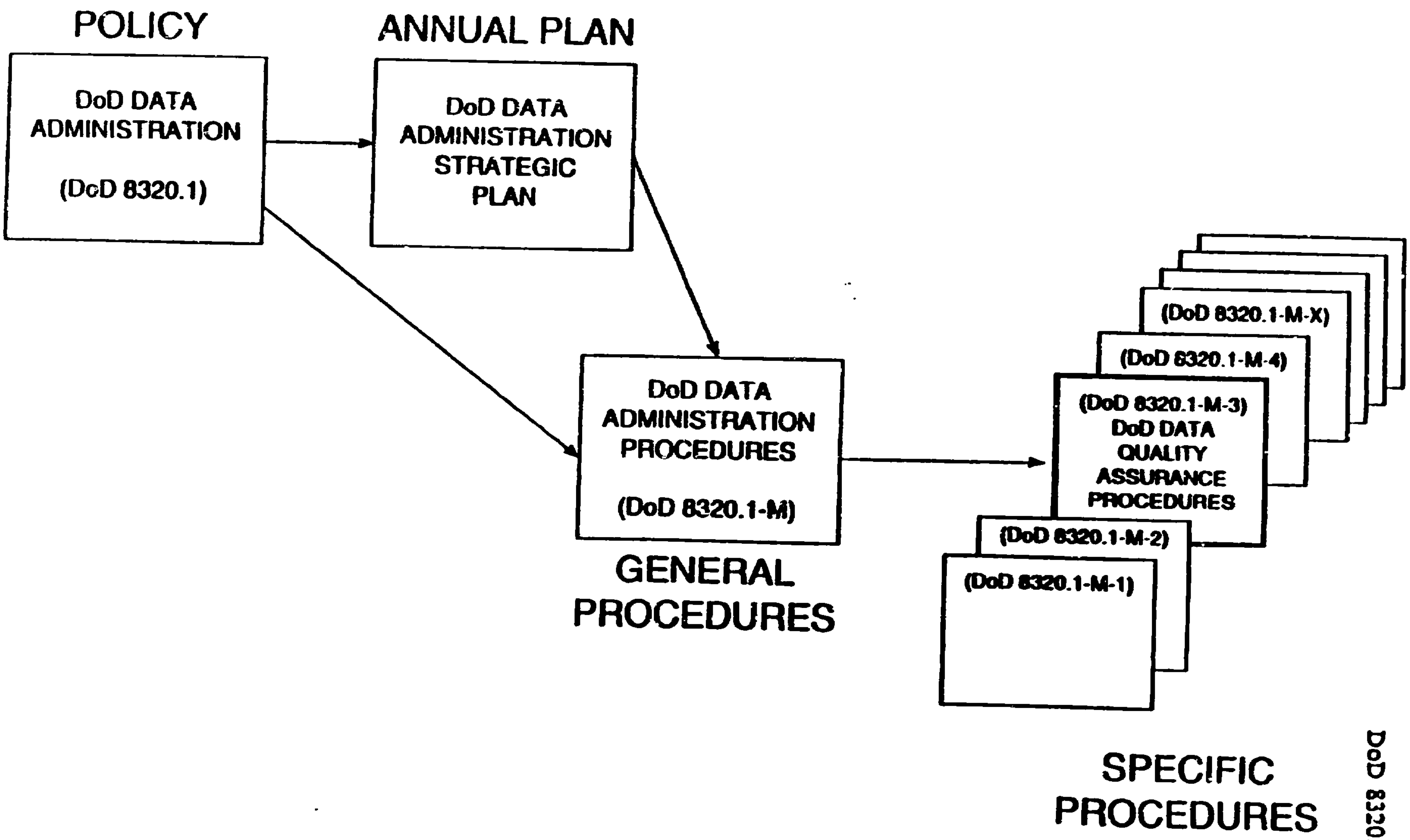


Figure 1-1 Cor[illegible] t of DoD 8320.1-M-3

E. ORGANIZATION OF THE MANUAL

1. The DoD Data Quality Assurance Procedures encompasses the process, methodology, tools and techniques which have evolved from the Total Quality Management (TQM) and Data Quality disciplines.

2. As Figure 1-2 describes, this Manual is organized into four major parts. Chapters 1 and 2 provide an introduction to the purpose of this Manual and the general concepts of data quality assurance. Chapter 3 introduces the DoD Total Data Quality Management (TDQM) process. Chapter 4 provides the methodology for implementing DoD Data Quality Engineering (DQE) methodology, which Chapter 3 introduces. Chapter 5 provides specific tools and techniques for performing the TDQM process and the DQE methodology.

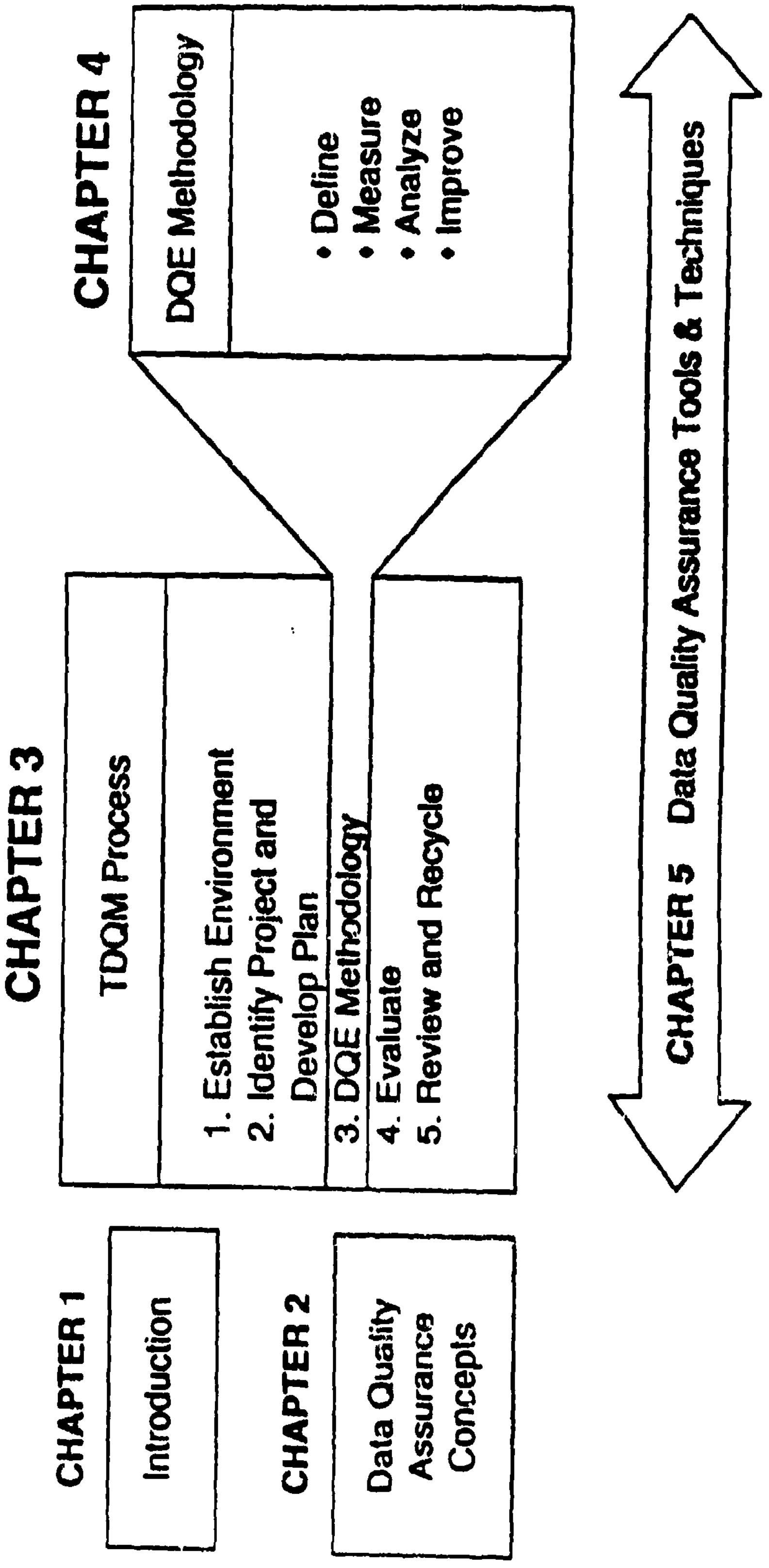


Figure 1-2 Organization of DoD 8320.1-M-3

CHAPTER 2

DATA QUALITY ASSURANCE CONCEPTS

A. INTRODUCTION

1. A data quality assurance program is integral to DAdm and ensures that DoD operations and decision making are supported with data that meets needs in terms of availability, accuracy, timeliness, and integrity (DoD 8320.1-M, reference (d)). Decision support systems will use quality data for planning and analysis. As a result, decision-making will be improved and information systems will be easier to use. Transactions and the exchange of technical and management information will be handled more quickly and accurately. In turn, a cost-effective operation and low overhead will be maintained (reference (d)).

B. DATA INTEGRITY

1. Data integrity is defined in FIPS PUB 11-3, "American National Dictionary for Information Systems," (reference (e)) as:

> "The state that exists when data is handled as intended and is not exposed to accidental or malicious modification, destruction, or disclosure."

2. This Manual addresses the validation and improvement of the quality of DoD data. Appropriate application of data security provides, at a minimum, the integrity, availability, confidentiality, and quality of an organization's resources. Data administrators (DAds), in assuring integrity, availability, and confidentiality, shall adhere to the DoD security guidance documents.

C. STANDARD DEFINITION OF DATA QUALITY

1. FIPS PUB 11-3 (reference (e)) defines data quality as:

> "The correctness, timeliness, accuracy, completeness, relevance, and accessibility that make data appropriate for use."

a. Data quality also incorporates the use of activity models, data models, entities, attributes, metadata, metametadata, schemas, and data architectures.

2. Data have several special properties which distinguish them from other products. Unlike manufactured products, data are intangible. Data have representations, but no actual physical manifestations. Since data are intangible, they lack directly measurable properties. Data meaning depends on the context in which they are used. For example, a data item called "provider" may mean the name of the insurance provider when used in a benefits tracking system or may mean the name of the health care professional who provides services to a patient when used in a hospital administration system. The lifetimes of data are indeterminate. Data do not deteriorate as they age and their potential lifetimes are very long. Finally, data are very susceptible to obsolescence. Data values change over time and any lags between cognizance of the change and the actual update of the data value means that there are periods when the data value is incorrect. Because data are very different from other products, they have their own quality characteristics ("Data Quality Engineering Study", reference (f)). In the following sections, characteristics of data quality are presented.

D. QUALITY ASSURANCE

1. Quality assurance is defined in FIPS PUB 11-3 (reference (e)) as:

> "The policies, procedures and systematic actions established in an enterprise for the purpose of providing and maintaining some degree of confidence in data integrity and accuracy throughout the life cycle of the data".

2. In order to assure quality data: (1) predetermined requirements for excellence must be established, and (2) the data must conform to these requirements. Table 2-1 is a broad list of the requirements of quality.

ACCESSIBILITY	FLEXIBILITY/MODULARITY
ACCURACY	INTEGRITY
ADHERENCE TO STANDARDS	INTERPRETABILITY
AMOUNT OF HISTORIC DATA	PRECISION
AUTHORIZATION	RELATABILITY
AVAILABILITY	RELEVANCE/RELEVANCY
BELIEVABILITY	RELIABILITY
COMPLETENESS	STABILITY
CONFIDENTIALITY	TIMELINESS
CONSISTENCY	TRACEABILITY
CORRECTNESS	UNIT OF MEASURE
CURRENCY	UNIQUENESS
EXTENSIBILITY	VALIDITY

Table 2-1 Requirements of Quality

a. Not all data must meet all of these requirements. Business requirements impose different quality requirements on data. Table 2-2 is the DoD core set of requirements for data quality.

Category of Requirement	Descriptions
Accuracy	(1) A quality of that which is free of error (ISO). (2) A qualitative assessment of freedom from error, with a high assessment corresponding to a small error (ISO). (FIPS PUB, reference (e)) (2) Correct data that conforms to models derived to support enterprise requirements and standards. (DoD 8320.1-M, reference (d)). (3) The quality or state of being accurate; deviating only slightly or within acceptable limits from a standard. (American Heritage, reference (g)) (4) Accuracy is "a measure of the degree of agreement between a data value (or set of values) and a source assumed to be correct". ("Data Quality Management and Technology", reference (h))
Completeness	(1) The quality of maintaining data which satisfies all demands or requirements. (reference (d)) (2) Having all characteristics; whole. (reference (g)) (3) Completeness is "the degree to which values are present in the attributes that require them". ("Data Quality Foundation", reference (i))
Consistency	(1) Data is maintained so that it is free from variation or contradiction. (reference (d)) (2) Agreement or logical coherence among things. (reference (g)) (3) Consistency is "a measure of the degree to which a set of data satisfies a set of constraints". (reference (h))

Table 2-2 DoD Core Set of Quality Requirements

Category of Requirement	Descriptions
Relatability	(1) The quality of data that permits it to be rationally correlated or compared with other similar or like data. (DoD 8320.1-M, reference (d)) (2) To bring into logical or natural association. To interact with others in a meaningful or coherent fashion. (American Heritage, reference (g))
Relevancy	(1) The state of maintaining data in a condition that provides the ability to retrieve the specific information needed by the user. (reference (d)) (2) Pertinent to the matter at hand. The capability of an information retrieval system to select and retrieve data appropriate to a user's needs. (reference (g))
Timeliness	(1) A condition which requires that a data item or multiple items are provided at the time required or specified. (reference (d)) (2) Occurring at a suitable or opportune time; well-timed. (reference (g)) (3) Currency is "a measure of the degree to which specified data values are up to date" ("Data Quality Management and Technology", reference (h)). In some cases, timeliness is a synonym for currency ("Data Quality Foundation", reference (i)). In others, timeliness has a completely different meaning - see timely accessibility. Timely accessibility refers to "the response to a user request for data should be returned in a timely fashion. If the system does not return the data when the user needs it, it may not be used" ("Managing The Data-Base Environment", reference (j)).

Table 2-2 DoD Core Set of Quality Requirements (continued)

Category of Requirement	Descriptions
Uniqueness	(1) The state of being the only one of its kind; sole. Being without an equal or equivalent; unparalleled. (American Heritage, reference (g))
Validity	(1) The quality of maintained data that is found on an adequate system of classification (e.g., data model) which is rigorous enough to compel acceptance. (DoD 8320.1-M, reference (d)) (2) The state or quality of being sound. Producing the desired results. (American Heritage, reference (g))

Table 2-2 DoD Core Set of Quality Requirements (continued)

E. THE DATA LIFE-CYCLE

1. DoD must manage the quality of data throughout the data life-cycle. Appendix A, "Life-Cycle Management of Data", of DoD 8320.1-M (reference (d)) identifies the stages of the data life-cycle. These stages are:

(a) Identification

(b) Standardization

(c) Acquisition

(d) Maintenance

(e) Archival

2. The identification and standardization phases identify and document data quality requirements for all data elements. Data quality requirements are defined from various authoritative sources during the identification and standardization phases of the data life-cycle. DAdm products, such as data models, the Defense Data Repository System (DDRS), and reverse engineering documentation document these requirements.

a. The final product of the standardization phase is the approved DoD standard data and metadata including entities, attributes, definitions, and data values. These data element standardization procedures provide the necessary framework to facilitate data exchange, maximize data sharing opportunities throughout the DoD, and enforce data standards.

b. Metadata can be viewed as a type of controlling framework that outlines a broad set of rules to which the data of interest to an enterprise must be in compliance. Data quality assurance is applied to the development of metadata. DoD 8320.1-M-1, "DoD Data Element Standardization Procedures," (reference (k)) and DoD 8320.1-M-X, "DoD Data Model Development, Approval, and Maintenance," (reference (l)) dictate the specific requirements and rules to ensure the quality of data models and standard data elements.

3. During the acquisition and maintenance phases of the data life-cycle, DoD database administrators (DBAd) develop and maintain physical data models based on approved logical models. They develop and maintain database structure using approved entities and attributes. DoD 8320.1-M-4, "DoD Database Administration," (reference (m)) documents these database administration (DBAdm) procedures. Data quality assurance is applied to the design, implementation and maintenance of physical databases.

a. The acquisition and maintenance phases ensure that data quality requirements are implemented properly in databases and application software. Technical development activities must develop rule sets and quality metrics (i.e., standards of measures) from data quality requirements to design filters (i.e., edit checks) in new databases, application software, and information systems (IS). Procedures for developing these rule-sets and quality metrics are discussed in Chapter 4 of this Manual. Users must perform data quality analysis to detect and prevent data value defects before they corrupt databases or end user applications. Where filters do not exist in legacy systems, the data must be extracted and examined manually or downloaded and analyzed with a data quality tool designed to generate the necessary filters. Any defects found as a result of the data analysis must be noted and forwarded for correction.

b. During the acquisition and maintenance stages, these Data Quality Assurance Procedures are applied to the data values in both DoD automated systems and data repositories. Therefore, a data quality baseline shall be established and measured for all DoD automated information systems (AIS) and data repositories using quality metrics. These data quality baselines are used to measure performance against target goals for data quality.

c. When data are no longer current, they are generally archived depending upon the requirements of the mission. Archived data, while not current, are still useful, and are sometimes required by law or regulations. It is especially important that the data be of the highest quality prior to being archived. By nature, there is less institutional knowledge regarding archived data; therefore, to be useful the archived data must be of high quality.

F. QUALITY METRICS

1. Data quality metrics provide the fundamental measurement capabilities that form the foundation of a data quality assurance process. These metrics provide the capability to detect and report data defects - data that fails to meet business or technical requirements. Data quality metrics use statistical methods and rule-based techniques. A metric is a process or algorithm that may involve statistical sampling, mathematical computations, and rule-based inferencing ("Zero Defect Data Workbook: Conducting A Data Quality Baseline Audit", reference (n)). Applying the metric to a DoD data sample produces measurements that will indicate the presence and level of data defects within the sample.

G. TOTAL QUALITY MANAGEMENT

1. Total Quality Management (TQM) is both a philosophy and a set of guiding principles and practices that represent the foundation of a continuously improving organization. It applies human resources and quantitative methods to improve the materials and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met now and in the future. It integrates fundamental management techniques, existing improvement efforts, and technical tools in a disciplined and focused continuous improvement process.

2. TQM addresses the quality of management as well as the management of quality. It involves everyone in an organization in a systematic long-term endeavor to develop processes that are customer oriented, flexible and responsive, and constantly improving on quality. Quality includes any factor of product or service of value to a customer. Ultimately, TQM is a means through which an organization creates and sustains a culture committed to continuous improvement.

H. COSTS OF DATA QUALITY

1. From an engineering perspective, cost of quality can also be viewed as the losses that are caused by a product's functional parameters deviating from its desired target value. A significant point is that the cost of quality increases, not only when the product is out of specifications, but also when the product falls within specifications but deviates from target values. With regard to data, rule-sets and metrics measure the quality of data. The cost of quality depends on the cost of proactively incorporating quality into the DoD data process, versus the cost of failure to build quality into the DAdm program.

2. As defined in the "Data Quality Engineering Study", (reference (f)), the cost of quality can be classified into four main categories: prevention costs, appraisal costs, internal failure costs, and external failure costs. The first two categories refer to the costs of incorporating quality, known as the costs of control and the last two refer to the costs of not meeting quality standards, known as the costs of failure of control.

a. Prevention costs are the costs of preventing data quality problems from happening. Included in this category are the costs of setting up a quality engineering infrastructure, training employees about quality, planning for quality and establishing methods and procedures for adding quality to data.

b. Appraisal costs are the costs of auditing and evaluating data quality. Money will be spent to inspect, test, and review data against quality requirements.

c. Internal failure costs are the costs to the organization responsible for poor quality. This category includes the costs of workarounds, redesign and rework.

d. External failure costs are the costs of poor data quality to the users. If the data error rate becomes unacceptably high, users may quit using the system and look for other data sources (including other ISs), try to manually collect data which already exists in the system, or create their own homegrown manual systems.

3. Problems with data quality result in a wide range of costs to the users. The following describe a few examples based on the categories of costs of quality:

a. Lost Business - Inaccurate data in airline reservation systems cause planes to take off only one-third to one-half full, costing airlines millions of dollars. A large New York securities broker misses a big trading opportunity when incomplete data is entered into a new risk management systems and loses more than $200 million.

b. Lost Production - Unreliable project management data cause aerospace firms and other government contractors to have cost overruns and late product deliveries. Unreliable production management data cause manufacturers to rework products not meeting quality standards.

c. Lost Assets - A data entry error causes an insurance company to issue a monthly check for $32,000 instead of the $32 to which the beneficiary was entitled. Incorrect billings cause utilities, telephone, and transportation companies to lose money.

d. Legal Liability - Inaccurate spousal information and home addresses in human resource ISs may prevent compliance with the Consolidated Omnibus Budget Reconciliation Act (COBRA). COBRA specifies that terminated employees are entitled to benefits coverage six months after they leave the company. Invalid warrants and old warrants in the National Crime Information Center (NCIC) Wanted-Persons File place people at risk of being falsely detained and arrested.

CHAPTER 3

TOTAL DATA QUALITY MANAGEMENT PROCESS

A. INTRODUCTION

1. DoD DAdm must ensure that DoD operations and decision making are supported with secure data that meets needs in terms of availability, accuracy, timeliness, and integrity. Therefore, DAds throughout DoD must manage the quality of data throughout the data life-cycle. To support these efforts, DoD DAdm has established a Total Data Quality Management (TDQM) process which shall be used to ensure DoD data quality.

B. DoD TOTAL DATA QUALITY MANAGEMENT PROCESS

1. The DoD Total Data Quality Management (TDQM) process encompasses the processes, methodologies, tools and techniques from the Total Quality Management (TQM) and Data Quality disciplines. TDQM applies the principals of TQM as described in DoD 5000.51-G, "DoD Total Quality Management Guide" (reference (o)) to the management of data. The five (5) steps of the DoD TDQM process are:

Step 1: Establish the Data Quality Assurance Environment

Step 2: Scope Data Quality Projects and Develop Implementation Plans

Step 3: Implement Data Quality Projects Using The Data Quality Engineering (DQE) Methodology

Step 4: Evaluate Data Quality Assurance Progress

Step 5: Review, Approve, and Implement Data Quality Assurance Recommendations

2. This Chapter describes the five TDQM steps used to perform DoD data quality assurance. Chapter 4 introduces the DoD Data Quality Engineering (DQE) methodology that supports the DoD TDQM Process. Chapter 5 describes the tools and techniques used in TDQM and DQE.

C. STEP 1: ESTABLISH THE DATA QUALITY ASSURANCE ENVIRONMENT

1. In this step, the management and cultural environments for data quality assurance are established. The TDQM process is a total organizational approach toward the continuous improvement of data. It requires DoD functional management to exercise the leadership necessary to establish the conditions for the data quality assurance to flourish.

2. By creating a constancy of purpose, a common direction for all organizational elements is established and ensures that efforts at all levels contribute to achieving broad objectives relevant to the entire organization. Communicating the organization's data quality goals and objectives throughout the organization is essential to focusing on improvement efforts.

Establishing the data quality environment consists of:

a. Performing Strategic Planning for Data Quality Assurance, and

b. Developing the Management and Cultural Environments.

3. Performing Strategic Planning for Data Quality Assurance

a. The DoD Data Administration Strategic Plan (DASP) (reference (c)) provides the comprehensive and long-term direction necessary to define, plan, implement, and operate the DoD Data Administration Program. The DASP, as documented annually, ensures that data products will be managed throughout the life cycles to improve business methods, efficiency of operations, and the quality of data. The DoD DAd is responsible for developing the long-term vision, mission, and goals for the DoD Data Administration Program. The DoD DAd also establishes the overall goals and objectives for data quality assurance.

b. Each Functional Data Administrator (FDAd) and Component Data Administrator (CDAd) prepares a strategic plan for their respective Functional Area or Component in accordance with the annual planning guidance provided by the DoD DAd. The Functional Area and Component DASPs must include the operational goals, objectives, and description of tasks for data quality activities. Throughout DoD, DAds and DBAds must incorporate their functional area or component data quality goals and objectives into their organization's annual plans. If required, the DoD DAd, FDAds, or CDAds will provide guidance and assistance in the development of these plans.

c. By assessing the vision of the organization's future and coming to a consensus on a data quality goal, the FDAd, or CDAd will solidify their understanding of the ultimate data quality goals. They must communicate that goal throughout the organization. The data quality assurance goal should be in concert with the organization's mission, the long-term vision of the functional area, and DoD DAdm. Realistic strategies to obtain these goals must be established.

d. Set Measurable Objectives. The data quality assurance objectives should be both measurable and quantifiable. The objectives must reflect the plans for the data migration strategy for the functional area and be in concert with the overall DoD DAdm objectives. The first objective should be to establish initial baseline assessments for the costs and quality of legacy and migration data. This initial baseline is used to identify significant improvement areas in which success is essential to DoD.

e. Develop Data Quality Assurance Action Plans. As part of the DASP, action plans should be developed for obtaining the objectives. The action plan should describe a strategy to meet the data quality goal, and should describe the organization's resources, tasks and milestones needed to implement the data quality objectives identified in the DASP (reference (c)). Resource requirements should also be provided for each action plan in accordance with the DASP guidance.

4. Developing The Management and Cultural Environment

a. Establish Who Is Ultimately Responsible. To create a successful data quality program, it is vital to determine the individual who is ultimately responsible for setting policy and for providing top-management functional support. In most cases in DoD, this would be the Functional Activity Program Manager (FAPM) or the Office of the Secretary of Defense,

Principal Staff Assistant (OSD PSA). However, depending on the organizational structure, look within line management and identify the functional manager who approves the organization's annual plan. This individual is critical to developing the data quality management and cultural environment.

b. Help The Functional Manager Become More Aware. When beginning to develop ideas for the initial data quality improvement effort, the first step for the DAd is to make sure that the functional manager is aware of the DoD IM initiatives and data quality concerns. Building management awareness of the need for change and the benefits of data quality improvements by the TDQM process, will help establish a foundation for continuous data improvement efforts. Awareness can be increased by providing information on the TDQM process, advocating the manager's attendance at DoD DAdm conferences on data quality assurance, and inviting his/her participation in TDQM activities. Training and seminars offered by recognized leaders in data quality assurance can also be instrumental in building awareness. Management should be made aware of DoD policies and procedures for data quality assurance through the review of DoD Directives and Instructions, and Procedure Manuals. The need for data quality assurance activities may also be demonstrated by citing specific incidences when poor quality has impacted performance within the organization.

c. Obtain Management Support - For any data quality assurance effort to be successful, management must support and approve the organization's overall plan for data quality. Top-management can send signals or exhibit behavior that can either greatly enhance data quality assurance progress or unacceptably restrict it. By obtaining management support, the potential for data quality improvements are great. Through encouraged manager's support, there is an increased potential to move the commitment to data quality assurance throughout the organization.

d. Prototype Effort. In order to obtain top-management support, the DAd and other functional experts may conduct a small, prototype effort. This effort should be used to make a case for the ramifications of having poor quality data and the costs associated with poor data. These assessments should be presented to top-management with a supporting Data Quality Plan. When selecting a prototype effort, choose familiar data that will not interfere with the ongoing business activities of the organization's current assignments. Choose data with low risk and low visibility, but that is critical to the organization's success. From these efforts, show the results of the data quality analysis and present overall cost estimates for poor data quality. From this prototype effort, attempt to gain management understanding and support to implement a TDQM program in the organization. Procedures for conducting a prototype effort are

discussed in detail under Step 2 below. Once support has been established, the organization should begin to establish the data quality environment.

e. Create An Environment In Which Continuous Data Improvement Is A Way Of Life. TDQM concentrates on providing quality data that consistently meets the needs and expectations of the user. Every member of DoD must know the purpose of his/her job, his/her customer(s), and his/her relation to others within DoD for providing end-user satisfaction. Everyone must know the data users requirements. The data quality objectives of each functional area of DoD must reflect a perspective that, when combined with other areas of DoD, will provide the synergy that produces "Quality Information for a Strong Defense".

(1) All DoD personnel must make continuous data improvement a part of the daily routine, whereby it is integrated into all aspects of work. Continuous data improvement only approaches maturity when it is applied routinely to all of the organization's efforts. Routine application entails ensuring data quality throughout the data life-cycle including collecting and using data. DAds and functional managers should also routinely assess process suitability and remove roadblocks to improvement efforts.

f. To build a cultural environment in which data quality becomes everyone's responsibility, the following strategies should be implemented: (1) Demonstrate Leadership, (2) Build Awareness, (3) Create Open Lines of Communication, and (4) Develop Teamwork.

(1) Demonstrate Leadership. A leader needs to be established for the data quality function. This individual will provide the lead for establishing baselines, performing assessments, prioritizing, providing solutions, and making final improvement recommendations. This role may be performed by the DBAd, DAd, AIS project manager, or technical developers. This individual has the overall operational responsibility for the quality of the data. This individual leader should be aware of the TQM discipline and DAdm. This leader will help top-management establish the cultural environment for implementing TDQM. The leader establishes a formal or informal DQE team consisting of the DAd, DBAd and other technical and functional experts and has the overall responsibility for implementing the DoD DQE methodology.

(2) Build Awareness. Building awareness (understanding what data quality assurance is and why it is important to the organization) is perhaps one of the most important steps in implementing TDQM. The organizatio must become aware of the need to improve the

quality of data and understand the various tools and methodologies available for improvement efforts.

(a) The development of DoD procedures provides an opportunity to make the organization more aware of TDQM efforts. As discussed above, it is also important to help the functional manager be more aware (through annual reports and assessment reports). DAdm strategic planning should plan for data quality assurance in the future. Everyone should become more aware of TDQM through training, seminars, and newsletters. Information should be shared (in terms of both progress and problems) across functional and component areas. The DoD DAd will publish annual reports on the progress of DoD data quality assurance.

(3) Create Open Lines of Communication. As the awareness of data quality assurance is being raised throughout the organization, begin to establish open lines of communication both horizontally and vertically. Open communication permits teams to work through problems, overcome barriers, and find encouragement and support from other data quality assurance efforts.

(a) Establish a process where data users can freely report problems with data, and can obtain quick resolution. Within the DoD organization, develop a monitoring and tracking process to allow for user feedback. These communication processes need to be developed with the organization's operating procedures to create an atmosphere that facilitates information sharing.

(4) Develop Teamwork. Teamwork is the engine that drives many improvement efforts. Creating teams allow the application of diverse skills and experience to problem solving. An atmosphere of teamwork should permeate the organization, affecting not only formal team efforts but also each individual's interaction in the organization. Within functional areas, performance improvement teams provide cross-functional orientation, and the employees on these teams become involved in process issues. Thus, the entire DoD is effectively interlinked to form an ideal performance improvement setting.

(a) DoD must implement the TDQM program using a structured teamwork approach, establishing DAdm work groups similar to TQM project action teams. These work groups are made up of DAds, DBAds, technical developers, program managers

(PM), and functional experts. These work groups are used to identify root causes and to develop recommendations for data quality improvements.

D. STEP 2: IDENTIFY DATA QUALITY PROJECT AND DEVELOP IMPLEMENTATION PLAN

1. The next step in the TDQM process is to identify a data quality improvement project. This data quality improvement project may be the organization's initial data quality effort, or may be a prototype effort to gain top management support. The DoD DAd will provide the guidance and consultation to support Steps 1 and 2 in a DoD TDQM effort. DoD DAdm establishes the overall DoD data quality assurance environment and will assist organizations in identifying improvement projects, and developing implementation plans and prototype efforts.

2. Choose Early Efforts in Visible Areas Critical To Success The success or failure of initial TDQM efforts and projects can greatly affect how easily the organization adopts TDQM ideas. Select projects that (1) have a high chance of success, (2) have the highest external costs and, (3) where the greatest improvements can be made. Addressing the critical issues and examining historical data problems first, increases the chance that the results will increase the attractiveness of TDQM to top management.

3. Prototype Effort. If there is not top management support for data quality efforts, perform a prototype effort, choosing a systems with low risk, low visibility, but that is critical to the organization's success. Focus on familiar data where individual expertise can be provided. Select an initial effort that is neither too large that it is doomed for failure from the start, or so small that improvements will essentially go unnoticed.

4. Identifying The Data Quality Project. When identifying a data quality project, many criteria should be reviewed to determine the suitability of the project. Prior to the evaluation and selection of data for data quality improvement (whether an initial effort or a prototype effort) a set of selection criteria must be developed. Major evaluation areas should be identified and selection criteria are to be developed for each area. The evaluation areas should focus on the availability of information needed for the DoD Data Quality Engineering (DQE) process detailed in Step 3. Criteria and weighting factors should be applied to evaluate, select, and perform the DoD DQE analysis. Chapter 5 provides a technique with specific evaluation factors for conducting the Data Selection Evaluation.

5. Once the data has been selected for the TDQM effort, project scope must be determined, including data quality metrics, and a specific implementation plan must be developed. For either an initial or prototype effort, the project should be developed in accordance with the goals and objectives identified within Step 1. This plan should detail the methods and tools required to (1) Minimize DoD data defects in the selected data sample, and (2) Reduce DoD data management costs.

a. Implementation Plan. Once the data has been selected, an implementation plan, to integrate DQE into the data quality project, must be developed. This will include identifying the processes and procedures required to operate DQE and to analyze and resolve identified data errors, and identifying how DQE will be used by the various components of the DoD DAdm infrastructure.

(1) Develop a detailed Plan of Action and Milestones for the application of DQE to the selected data elements. This will include identifying and prioritizing the detailed tasks, and subtasks, required to implement the DQE. From initial analysis, identify the target database, and obtain the appropriate information on the data structure, content, support organization and other required details. Also, define the objective metrics designed to measure the continuous improvement of the quality of the metadata as a result of the DQE implementation.

(2) Define the methods and tools to be used. Establish the required costs associated with acquiring these tools. Also define the techniques for evaluating and utilizing the tools for capturing data quality business rules, measuring the data and providing statistical reports using metrics.

(3) Finally, an overall project schedule and funding schedule should be presented. These schedules will define actual deliverables and target dates of completion. An overall resource funding schedule should also be prepared and presented.

6. Step 1 and Step 2 provide the functional infrastructure to begin to implement a TDQM project. Step 3 Implement Data Quality Projects Using The Data Quality Engineering (DQE) Methodology provides a technical, structured approach for data quality improvement efforts.

E. STEP 3: IMPLEMENT DATA QUALITY PROJECTS USING THE DATA QUALITY ENGINEERING (DQE) METHODOLOGY

1. The analysis and improvement of data relies on a structured approach, such as the DoD Data Quality Engineering (DQE) methodology. The DoD DQE process consists of a methodology supplemented by an automated tool to clearly define the source of persistent problems with data and database systems. The DQE process includes precise techniques for selecting the best corrective actions and monitoring the progress towards achieving data quality objectives. The overall objectives of the DQE methodology are to assess and validate specific problems, identify root causes, and improve the quality of the data. In order to meet these objectives, the DQE methodology first determines the exact nature and magnitude of the problem base. DQE analyses focus on the logical data structure, data element definitions, and data values (the actual "instances" of data). Further, the DQE methodology supports the selection of a quantifiable "measure of success" and supports iterative assessments of progress toward the objective. The methodology does not stop with the problem definition and identification of cause, it also points the analyst toward (or "triggers") a technique (e.g., data modeling, process modeling, data standardization, policy or procedure modifications, training requirements) that will correct the problem. In short, the DQE methodology identifies problems and root causes, triggers an appropriate, cost effective, focused, improvement process, and provides a means of measuring success ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)).

2. In DoD, the DQE methodology is used is to implement a data quality assessment project, identified in Step 2 of the TDQM process, or to investigate an end user's observation of a specific data quality problem. The data quality assurance leader identified in Step 1 of the TDQM process has the overall responsibility for implementing the DoD DQE methodology. The leader establishes a formal or informal DQE team consisting of the DAd, DBAd and other technical and functional experts. Throughout the DoD DQE effort, the leader meets periodically with team members to exchange ideas, review interim findings, seek answers to specific questions, and resolve issues. The results of a DoD DQE effort are documented in a Data Quality Baseline Assessment Report. The procedures for developing a Data Quality Baseline Assessment Report are presented in Chapter 4 of this Manual. The report not only describes the current baseline for the quality of data, but also the baseline of the associated poor quality costs.

3. The DoD DQE methodology is comprised of four (4) major activities: DEFINE, MEASURE, ANALYZE, and IMPROVE. Chapter 4 describes the complete DoD DQE methodology in detail. Chapter 5 introduces the tools and techniques to implement the DoD DQE methodology.

F. STEP 4: EVALUATE DATA QUALITY ASSURANCE PROGRESS

1. Measurement, evaluation, and reporting are essential elements of the TDQM process. These elements focus on the effectiveness of improvement efforts and identify areas for future improvement efforts. Information on TDQM efforts should be forwarded by the DQE team leader to the DoD DAd so that it can be included in annual reports and included in future strategic plans.

a. Implementation Plan Performance Data. A basic need in all improvement efforts is the ability to measure the value of the improvement in units that are pertinent and meaningful to the specific tasks, as identified in the project Implementation Plan. Improvement is evaluated on the factors of both performance and cost.

(1) Data Quality Measures. Using established data quality metrics (procedures in Chapter 4) will measure data performance against target goals for data quality. These metrics will detect and report data defects - data that fails to meet business or technical requirements. Applying the metric to a DoD data sample produces measurements indicates the presence and level of data defects within the sample.

b. Baseline Assessment Data. The DoD DQE methodology provides the DAd with a means for identifying and assigning responsibility for corrective actions. A data quality baseline is always established in the initial DoD DQE effort. The DAd can then assess progress toward achieving data quality by conducting periodic, identically configured DoD DQE evaluations on the database. This provides a comprehensive indication of compliance with the quality specifications over a specified time period.

2. As part of the information forwarded for the annual reports, the following should be included in a section on accomplishments, or in a summary report: (1) Identify The System Selected, (2) Identify The Number of Data Elements Assessed, (3) Identify The Number of Data

Errors Detected, (4) Identify The Number of Data Errors Corrected, and (5) Discuss The Overall Data Quality Improvements Made.

3. Evaluate Cultural Environment. In this stage, all procedures for data quality assurance should be re-evaluated. The overall DASP should be reviewed and updated accordingly. With regard to cost, there must be a determination of what is the acceptable percentage of defect data (target parameters) versus the cost of obtaining zero data defects.

G. STEP 5: REVIEW, APPROVE, AND IMPLEMENT DATA QUALITY ASSURANCE RECOMMENDATIONS

1. Within Step 5, review all actions taken an determine which areas can be improved upon. All DoD employees will need to review progress with respect to improvement efforts and modify or rejuvenate existing approaches to data quality assurance for the next progression of methods. This constant evolution reinforces the idea that TDQM is not a program, but rather a new day-to-day behavior for the entire DoD.

2. A DAdm performance improvement work group should develop measures that are appropriate for re-evaluating their TDQM process. This would include reviewing cost baselines and performance results. The DoD DAd should also review these performance results against the overall goals and objectives for data quality assurance.

3. As part of the review process, action plans should be reviewed by the DoD DAd, FDAds, or CDAds for the achievement of data quality assurance objectives. These action plans should have met the data quality goal, and should have described the organization's resources, tasks and milestones needed to implement the data quality objectives identified in the DASP (reference (c)). Resource requirements should be analyzed, in reference to each action plan, to determine areas of improvement. Training resources must be made available to support the organization's continued TDQM improvement efforts. Training plans should be updated to provide an immediate opportunity to use new skills developed throughout the TDQM project.

4. Data quality recommendations may focus on developing and executing Functional Process Improvement (FPI) initiatives to reduce future data defects. Any system and/or process defects found as a result of the DQE effort should have been forwarded to the FAPM for

correction. The FAPM should also identify and analyze root causes of data defects, identify opportunities for systems and/or process improvements, and prepare an implementation plan for approval in accordance with the FPI procedures described in DoD 8320.1-M, "Interim Guidance on Functional Process Improvement" (reference (q)). DoD DAdm must perform quality control activities to track and document continuous process improvements for DoD data quality assurance.

CHAPTER 4

DoD DATA QUALITY ENGINEERING METHODOLOGY

A. INTRODUCTION

1. The DoD methodology introduced in this Chapter was derived from a proven U.S. Marine Corps Data Quality Engineering (DQE) methodology. Appendix A presents the application of the DQE methodology to the DoD data environment (the U.S. Marine Corps). Through technical research, evaluation and prototyping activities, it has evolved into a standard DoD DQE methodology. This DoD DQE methodology supports the Total Data Quality Management (TDQM) process that Chapter 3 identifies.

B. DoD DATA QUALITY ENGINEERING METHODOLOGY

1. The following sections describe the DoD DQE methodology. This methodology is based on the Total Quality Management philosophy, the U.S. Marine Corps DQE methodology, and encompasses research and evaluation of other data quality methods, tools and techniques. The Data Quality Engineering methodology (supplemented by tools and techniques) clearly defines the source of persistent problems with data and database systems. The DQE process also includes precise techniques for selecting the best corrective actions and for monitoring the progress toward achieving data quality goals. The success of the DQE methodology rests in the efficiency of an innovative, "data-centered" approach. The DQE methodology allows analysts to achieve detailed, quantified definitions of data problems ("Data Quality Engineering (DQE) Pilot Project, Technical Report", reference (p)).

2. The overall objectives of the DQE methodology are to assess and validate specific problems, identify root causes, and improve the quality of the data. In order to meet these objectives, the DQE methodology first determines the exact nature and magnitude of the problem base. DQE analyses focus on the logical data structure, data element definitions, and data values (the actual "instances" of data). Further, the DQE methodology supports the selection of a quantifiable "measure of success" and supports iterative assessments of progress toward the objective. The methodology does not stop with the problem definition and identification of cause, it also points the analyst toward (or "triggers") a technique (e.g., data modeling, process modeling, data standardization, policy or procedure modifications, training requirements) that

will correct the problem. In short, the DQE methodology identifies problems and root causes, triggers an appropriate, cost effective, focused, improvement process, and provides a means of measuring success ("Data Quality Engineering (DQE) Pilot Project, Technical Report", reference (p)).

3. In DoD, the DQE methodology is used is to implement a data quality assessment project, identified in Step 2 of the TDQM process, or to investigate an end user's observation of a specific data quality problem. The data quality assurance leader identified in Step 1 of the TDQM process has the overall responsibility for implementing the DoD DQE methodology. This leader establishes a formal or informal DQE team consisting of the DAd, DBAd and other technical and functional experts. Throughout the DoD DQE effort, the leader meets periodically with team members to exchange ideas, review interim findings, seek answers to specific questions, and resolve issues. The results of a DoD DQE effort are documented in a Data Quality Baseline Assessment Report. The report not only describes the current baseline for the quality of data, but also the baseline of the associated poor quality costs.

4. The DoD DQE methodology is comprised of four (4) major activities: DEFINE, MEASURE, ANALYZE, and IMPROVE. The DEFINE activity focuses on identifying data quality requirements and establishing metrics. The MEASURE and ANALYZE activities focus on measuring and assessing the data quality, identifying root causes of errors, and analyzing opportunities for improvement. The IMPROVE activity focuses on developing and executing improvement initiatives for correcting data defects. The DoD DQE methodology is compatible with Step 5 of DoD TQM model basic performance improvement cycle as described in DoD 5000.1-G, "DoD Total Quality Management Guide", (reference (o)).

5. Figure 4-1 is an activity model that depicts the DoD DQE methodology. The activity model is for exposition only (FEO) (i.e. for the purposes of depicting these procedures). The model is depicted using the IDEF0 modeling technique. The dashed lines represent the controls, mechanisms and outputs that exists for every activity. Guidance are the directives, instructions, or procedures that describe and govern the roles and processes for implementing the DQE methodology. Tool Requirements are developed as a result of attempting to perform any activity. The Plan Performance Data are used to document the actual resources utilized, accomplished and objectives achieved as a result of performing each activity. The mechanisms, the DQE team, Common Tools and Source Data Experts, are actually implemented or are used to perform each activity. Common Tools are described in Chapter 5 of this Manual. The DQE team meets regularly throughout the DQE process and are considered a dedicated resource until

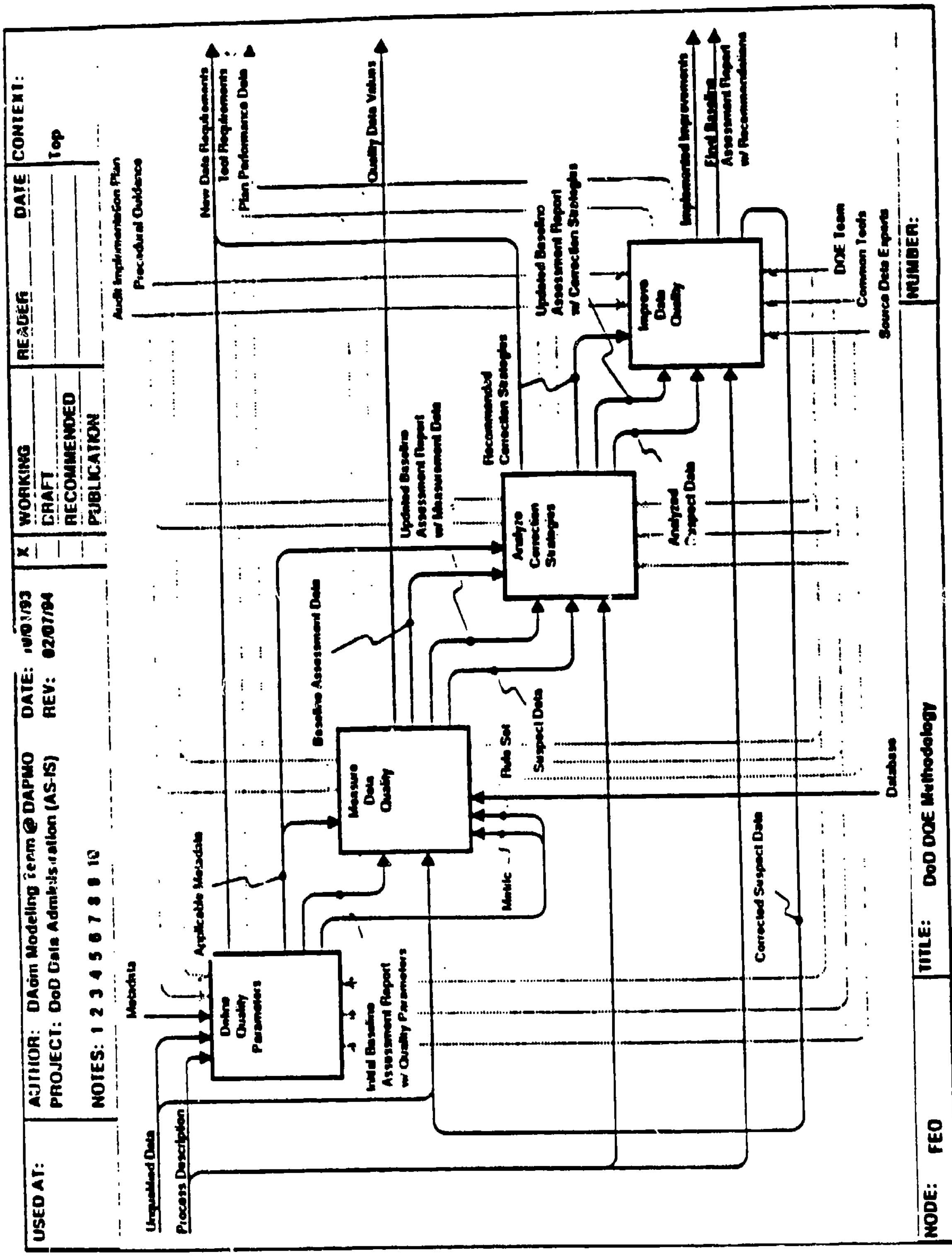


Figure 4-1 DoD DQE Methodology

the process is complete. The Source Data Experts, although not on the DQE team, are called upon throughout the DQE process for consultation and validation during the DEFINE, MEASURE and ANALYZE activities, and to implement corrective actions and improvement opportunities during the IMPROVE activity. The following sections discuss in detail each of the activities of the DoD DQE methodology.

C. DEFINE

1. The DEFINE activity focuses on identifying data quality requirements and establishing metrics. All of the preliminary activities necessary to measure and assess the data quality are performed as part of the DEFINE activity. The steps, tools, and techniques of the DEFINE activity are presented in Table 4-1 below.

OBJECTIVES	DEFINE ACTIVITY STEPS	TOOLS/ TECHNIQUES
Identify data quality requirements and establish metrics.	1. Scope the Problem 2. Identify and Review Documentation 3. Develop Quality Parameters	DDRS Data Selection Data Model Activity Model NGT Cost of Quality Control Chart QFD DTR Pareto Chart Histogram

Table 4-1 DoD DQE DEFINE Activity

2. Scope the Problem.

a. In the first step, "Scope the Problem", the DQE team will determine the specific data quality problems for the assessment and gather the appropriate data experts and supporting information. In order to scope the problem, the DQE team must:

(1) Determine the Objective

(2) Identify Data Experts

(3) Identify Historical Data Problems (If Available), and

(4) Identify Information and Processes That Need To Be Addressed

b. Determine the Objective. The DQE team must agree on a clear objective for the data quality engineering effort. Agreeing on an objective helps the team to develop a shared focus, provides a sense of direction, eliminates frustration and conflict between the members, and builds trust in order to gain acceptance. This is important because, as assessments and analyses are performed, functional and technical experts responsible for the data should not point blame or feel threatened because of suspect data errors or root causes. The objective is also used for measuring the success of the baseline assessment and to ensure that the team remains focused on the scope of the project while assessments and analyses are being conducted. The objective should include the type of data that the DQE team plans to assess.

c. Identify Data Experts. Once the objective has been determined, the DQE team should identify the experts (i.e. end users, data entry clerks, DBAds, programmers) that have knowledge of the how the data values are created, updated, and maintained. These data experts should also understand the objective and be available for consultation throughout the DQE effort.

d. Identify Historical Data Problems. To prepare for the development of quality parameters for the assessments, the DQE team along with the data experts should identify specific historical data problems or concerns for the selected type of data. Data quality requirements should be based on business and end user requirements. Business requirements can be gathered from existing policies, procedures or other documentation corresponding to the data. Some techniques that would be useful in developing a set of end user requirements are: interviewing, brainstorming, and the Nominal Group Technique (NGT). (Chapter 5 of this

Manual further defines these tools and techniques.) The NGT is similar to brainstorming and is especially effective with new DQE teams or data experts that are reluctant to disclose opinions, ideas, and feelings. If several problems are identified the business and end user requirements should be analyzed to further scope the data quality problems. If the DQE effort is part of an ongoing data quality improvement initiative, whereby the data quality baseline is being reassessed or reestablished, then previously prepared tools such as the Pareto Chart, Histogram, or Checksheet would also be useful. A useful tool to analyze the business and user requirements is the Quality Function Deployment (QFD). The QFD tool may also be used to establish new data quality requirements in order to expand the baseline for assessment. The process for using QFD is:

(1) Categorize the end user needs or business requirements into the data quality classifications identified in Chapter 2 of this Manual. (e.g. accuracy, completeness, consistency, timeliness); and

(2) Within each category prioritize the requirements in order of importance or impact to the organization ("Teams for Excellence: Skills, Strategies, & Implementation Exercise Book, reference (r)).

e. <u>Identify Information and Processes That Need to Be Addressed.</u> Once the most specific, historical data quality problems have been identified, then the DQE team should begin to identify supporting information and processes for the data. This task helps the team to focus in on the documentation and systems that will need to be reviewed in the second step of the DEFINE activity.

2. <u>Identify and Review Documentation</u>.

a. The overall purpose of this step in the DEFINE activity is to identify the applicable metadata and physical data structures that will be necessary to develop the quality parameters. An extensive amount of time may be spent on this step, depending on the amount of effort required to identify and gather the necessary documentation. In many cases, due to the lack of configuration control applied to the maintenance of documentation for legacy systems, data, and application code, the information is either outdated or nonexistent. In some cases, even the most recent documentation is not current or understandable. As DoD migration systems are reverse engineered, it is important to continuously update the documentation along

with the system or data it describes. As a result, a technical expert (e.g. data analyst) will be able to perform the following steps:

(1) Review the Defense Data Repository System (DDRS) For Standard (Candidate or Developmental Data Elements)

(2) Review Logical Data Model

(3) Analyze System Or Reverse Engineering Documentation

(4) Review Policies and Regulations

(5) Assess If There Is Enough Information To Proceed, If Not, May Have To Do Full Or Partial Reverse Engineering

b. Review The DDRS. As DoD data elements are standardized, standard data quality parameters (rule sets and metrics) will be made available for assessing data quality. Therefore, the data analyst should first review the standard data elements in the DDRS for the metadata that is most applicable to the information. If a standard data element is not available, consider using a candidate or developmental data element. Also review the data elements in the system or organization data dictionary for the availability of applicable metadata.

c. Review Logical Data Model. If a data element is identified for use from the DDRS, then the DoD Data Model or associated logical data model should be reviewed. Otherwise, functional area/activity, Component or organization logical data models should be reviewed. These data models are developed during the Identification and Definition phase of the Data Life Cycle (see Chapter 2 of this Manual) either through top down data modeling or reverse engineering efforts and as a result of performing a Business Process Improvement Project as described in DoD 8020.1-M (reference (q)).

d. Analyze System or Reverse Engineering Documentation. In order to gain a better understanding of the current physical data structures, the data elements, and the business processes that the system and data support, the source system database structure should be analyzed. This source system detailed database structure review begins with an analysis of the data element metadata instances, the database specification, data and process models, system

functional description documents, and system design specifications. Baselining the current data structures and the available documentation lays the foundation for the data analysis process.

e. Review Policies and Regulations. Review policies and regulations to identify specific information that would be applicable to the data. Such information may consist of associated procedures, allowable values, responsible personnel, and timeliness criteria. It is important to obtain the most current documents and be aware of any that are undergoing modifications.

f. Assess If There is Enough Information to Proceed. It is not unusual for some or all of these documents to either be outdated or nonexistent. Depending on the necessity, the information required will be derived either informally or formally. Throughout the DEFINE activity the DQE leader needs to assess if enough information is available to proceed with the DQE effort. If not, a full or partial reverse engineering project may have to be conducted. The DQE methodology does not require a full reverse engineering effort, but overall the reverse engineering products will provide significant input into the DQE effort and will reduce the un-front analysis time. When conducting a reverse engineering effort it is important to capture as much information to identify new data requirements for standardization (complete with domain and range information for the allowable data values). This analysis is required to derive the correct DQE quality parameters, described below. A reverse engineering effort, considered an activity outside of the TDQM process, is implemented using a different methodology.

3. Develop Quality Parameters.

a. If enough information is available to proceed, then the DQE team should begin to conduct an extensive analysis of the available information and develop quality parameters. The steps are:

(1) Identify and Retrieve Data Element Values To Be Assessed (Data Element values, Physical Tables, Specifications For Data Retrieval)

(2) Map Data Elements To Standard Metadata

(3) Prepare Rule Sets From Business Rules, Systems and Data Specifications, Policies, Regulations and Procedures

(4) Develop Metrics

(5) Record Analysis Results

b. Identify and Retrieve Data Element Values to be Assessed. After the initial review of the system and data documentation, the data elements for the unqualified data values are identified, and a specification for a data extract is prepared. The specification will include the structures and associated data elements required to undergo the DQE process. Selection parameters will also be included if required (if for example, it is required to subset the data). It is critical that the download specification include all of the values for the data elements required to build the operational rule sets that will actually check the data. In cases where a specific domain and range cannot be found in existing documentation, the DoD DQE team establishes a tentative domain and range that is based on a study of a series of actual data values and functional validation.

c. Map Data Elements to Standard Metadata. DoD DQE specifications are developed by following a structured, carefully designed data analysis process that results in the establishment of standard metadata and the business rule set. Standard, consistent metadata is the foundation for accurate data. Analysts should study the data structures, the data values (the actual "instances of data"), and related models, orders, documents and regulations. Standardization analysis techniques are used in order to establish standard and valid definitions, formats, domains, and ranges. Data modeling techniques are used to establish data and structure relationships and the associated business rules. The following interrelated analysis phases are supported throughout by functional user validation ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)):

(1) High-Level Consistency Analyses. This series of analyses identify inconsistencies in data element definitions and usage within a given database. The analyses identify identically named elements with differing formats, identically named elements with multiple definitions, and differing data elements having similar definitions.

(2) Collision Analysis. This series of analyses compares data element definitions to a DoD standard, Joint, functional area, Component, or other data elements. The analyses facilitate later data exchanges and provide the foundation for establishing valid definitions, formats and domains in conformance with higher order standards.

(3) Data Structure Analysis. This effort establishes relationships between data elements based on prime words, class words, and domain and range specifications. This study results in a logical data model, provides a map of data elements and constructs across heterogeneous databases, and establishes the business rules required to validate the data.

(4) Domain and Range Analyses. The product of this set of analyses is the set of legitimate values for a given data element. This is based on a study of actual sets of data values stored in one or more databases, the review of documentation provided by authoritative sources, and interviews with functional and technical experts.

e. Prepare Rule Sets From Business Rules, Systems and Data Specifications, Policies, Regulations and Procedures. The standard metadata and business rules resulting from the analysis process are used to prepare generic and specific rule sets. Generic rule sets are those rules (i.e. standard algorithms) that apply to the data independent of an automated system. The generic rule is transformed into specific file-unique rule sets. Specific rule sets are the actual code that is executed in the system or DQE tool that will actually perform the assessment. For a non-automated assessments the specific rule may actually be the specific operating procedure that will be executed to assess the quality of data on a form or report. Regardless of how the specific rule is used, it is generated from a generic rule to quality engineer particular data. Some generic rule types include ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)):

(1) Null constraints - Testing for Unqualified Zero and Null Data Values

(2) Domain and Range Validation - Testing for Data Values Outside Domains and Ranges

(3) Operational Rule Sets - Testing for Data Values Not Complying With Calculated Values

(4) Relationship Validation - Testing for Data Values Not Compliant With Business Rules

(5) Statistical Tests - Testing for Data Values +/- 2 Standard Deviations From a Calculated Data Element Norm (Numerical Fields Only)

f. DQE generic and specific rule sets should be generated for each data element to be checked. For an example of rule set generation, see Table 4-2. The development of generic and specific rule sets is an iterative process that depends on functional and technical expert validation. Many times the validation and refinement of specific rules will occur after the data values are measured. The specification indicates the valid format for the data element, the valid domain and range, the horizontal relationships that the element participates in across the record (the application of business rules to the element set), any cross record relationships (referential integrity and relationship checks), and any vertical relationships that the element participates in within its particular column (the application of statistical and anomaly testing). Generic DQE rules should be recorded in the DDRS or dictionary and, in the next step, implemented as specific rules sets. There is no limit on the number of specific rules that can be defined to check the data values in a given field.

Historical Data Problem Statement	Rule Type	Generic Rule Set	Specific Rule Set
The equipment identifier fields are often blank.	Null Constraints	If the equipment identifier is zero, blank, or null then error.	Select equip_id where equip_id = 0 or equip_id =' ' or equip_id is NULL;

Table 4-2 DoD DQE Rule Set Generation

g. Develop Metrics. Metrics (specific measures that indicate how "good" the data are) are developed as an integral component of the data analysis phase. As with the rule sets, there is a set of metric types that are defined generically. As a particular file is analyzed, the generic metric types are tailored to work with that file. The generic metric types are highly analogous to the rule types and include the following ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)):

(1) Consistency Measures

(2) Redundancy Measures

(3) Completeness Measures

(4) Valid Value Conformance Measures

(5) Relationship Rule Conformance Measures

(6) Referential Integrity Conformance Measures

h. During the MEASURE activity, the data are assessed against a goal for the metric. For example, in most cases it is desirable for the referential integrity, consistency, completeness, valid values, and relationship rules measures to strive toward a goal of 100% conformance with quality specifications, while redundancy measures should target a 0% assessment. These metrics are used to establish the data quality baseline. The DQE team should determine the display tools that will be used for reporting and analyzing the data quality baseline. Such tools may include, Pareto Charts, Histograms, Pie Charts, Tables, and Control Charts. Refer to Chapter 5 of this Manual for more information on these tools and techniques.

i. Record Analysis Results. The structured analyses should provide the DQE team with an expert knowledge of the data baseline. Throughout the DEFINE activity, the DoD DQE team should be capturing and recording standard or standards compliant metadata. The metadata includes data element definitions, formats, general and specific domains and ranges, and the logical data model (including the business rule set). Wherever possible, new data requirements should be forwarded for standardization in accordance with DoD 8320.1-M-1 (reference (k)).

D. MEASURE

1. The purpose of the MEASURE activity is to determine the exact nature and magnitude of problems with the real data values. The objectives of the steps are to prepare tools and procedures for performing the measures, assess the data values against the quality parameters, record and validate suspect data errors, refine the rule sets and calculate the data quality metrics. It is at this phase that the DQE team establishes the data quality baseline assessment. Functional and user feedback is vital at this stage, to ensure the assessment data is valid and depicts an accurate picture of the real data quality problems. The steps, tools, and techniques of the MEASURE activity are presented in Table 4-3 below.

OBJECTIVES	MEASURE ACTIVITY STEPS	TOOLS/ TECHNIQUES
Measure and assess the data quality.	1. Configure and Run DQE Tool (If Available) 2. Apply Rule Sets To Data Instances 3. Flag Suspect Data 5. Review Rule Set Validity, If Not Valid, Redefine 4. Calculate Metrics To Produce Reports	DDRS Data Model Benchmarking Control Chart DTR Pareto Chart Histogram DQE tool Checksheets

Table 4-3. DoD DQE MEASURE Activity

2. Configure and Run DQE Tool. DQE tools are automated or non-automated applications that aid in the prevention, detection, correction, and monitoring of data quality problems. In order to assure data quality, the most cost effective activity is to prevent initial defects. Therefore, technical developers should build data quality tools into the design of a database and all of its interfaces. Currently some Database Management Systems (DBMS) or application programs already provide internal tools to aid in maintaining quality data. In most cases, this consists of data quality checks being performed as edits on data entry. Since DBMS and application programs are not designed to perform data quality checks whenever the data are manipulated, copied, transferred, or converted, separate analysis and correction (i.e. DQE) tools are needed by technical experts to detect and correct errors after they have been stored in the system. The advantage of an automated DQE tool is that, it is a data-driven architecture that can be reconfigured quickly and easily to input new file specifications and DQE specific rule sets. But, as DoD legacy systems migrate to target systems, technical developers must build data quality engineering into the design of the new system, thereby phasing out the need for separate DQE tools. For non-automated data quality engineering efforts, the DQE team should establish standard operating procedures with users for detecting, documenting, and reporting errors. The team should establish the measurement technique (i.e. sampling) and design a Data Trouble Report (DTR) along with instructions for use. The automated DQE tool should be configured to produce graphic and tabular data error reports.

3. Apply Rule Sets To Data Instances. Once configured, the DQE automated tool or non-automated procedures should be implemented to process the specific rule sets against real data instances. Data values are subject to checks based on the operationally oriented (if...then...) rule sets, identified in the DEFINE activity. The rules sets are executed to check for invalid null constraints, duplicate records, and invalid domains and ranges. The rule sets are also used to check for errors by comparing a given data value to a calculated value using related data in a given record or database. For non-automated procedures, the rule sets should be applied to data values from existing hardcopy files; or the rules may have to be applied over a time period to new data as it is being collected in the functional process.

4. Flag Suspect Data. As the rule sets are processed, the suspect data values should be extracted from the data file along with information on the data elements that fail one or more DQE checks. All of the flagged suspect data should be compiled to create a Data Error Report. The Data Error Reports should be documented in the appropriate section of the Data Quality Baseline Assessment Report. For non-automated checking, as suspect data is identified, each error should also be documented on a Data Trouble Report (DTR). An automated tool could be used at this point to create and submit the DTRs to the DQE leader. Both the data error report and the DTRs are used in the ANALYZE and IMPROVE activities to track and monitor corrective actions.

5. Review Rule Set Validity, If Not Valid, Redefine. The MEASURE activity is an iterative process. The data analyst should work with the data experts to review and validate the flagged errors as true data errors. In many cases the rule set is just too generic causing it to need adjustments in order to capture valid errors. As a result, the generic and/or specific rule set should be refined and the tool reconfigured with minimal effort. But, there may be times when more information is required from the DEFINE activity because initial historical problems were not stated properly or they were inaccurately transformed into quality parameters. This results in the data analyst going back to the DEFINE activity to further the analysis and redesigning of the quality parameters.

6. Calculate Metrics To Produce Reports. Once the measurement is complete, all of the flagged suspect data should be grouped into failure categories, tallied, and used to calculate the metrics. The results from the metrics calculation depict the overall results of the MEASURE activity and are considered the baseline assessment data. The baseline assessment data displays, in quantifiable terms, how good or bad the data quality really is. The automated DQE tool provides the capability to perform identically configured checks in specific time intervals. This provides an ideal method of producing graphical reports based on current and previously

established baseline assessment data. These reports can be used to measure progress made towards achieving data quality over time. These reports should be formally documented in the appropriate section of the Data Quality Baseline Assessment Report.

E. ANALYZE

1. The purpose of the ANALYZE activity is to identify and analyze root causes for the occurrences of data errors and to identify opportunities for improvement. One objective of the steps of this activity is to employ the assistance of functional and technical data experts who are most familiar with the data, systems and processes, to identify and validate possible root causes. This activity also includes analyzing the impact of poor-quality costs to identify solutions for data error problems and providing recommendations for improvement opportunities. The steps, tools, and techniques of the ANALYZE activity are presented in Table 4-4 below.

OBJECTIVES	ANALYZE ACTIVITY STEPS	TOOLS/ TECHNIQUES
Identify root causes of data errors and analyze opportunities for improvement.	1. Identify Sources Of Erroneous Data 2. Contact and Involve Functional Data Steward, Along With Other Functional, Technical, and Data Experts 3. Analyze Data Value Problems/Errors To Identify Root Cause Of Error 4. Develop Poor-Quality Cost Baseline For Root Causes 5. Determine Recommended Solution Alternatives and Improvements for Root Causes	DDRS Data Model Activity Model NGT Cost of Quality Control Chart DTR Pareto Chart Histogram DQE Tool Checksheets Cause & Effect Process Flow

Table 4-4 DoD DQE ANALYZE Activity

2. Identify Sources Of Erroneous Data. The first step in implementing an effective corrective action is to identify the data source, and the data steward. The DoD DQE team examines suspect data where more than one source for similar data exists and if necessary, determines the best source for the data based on the quality assessments provided by the DoD DQE tool. Data stewards or experts are determined to identify the correct people required to support the DQE team in resolving data problems.

3. Contact and Involve Functional Data Steward, Along With Other Functional, Technical, and Data Experts. Individual efforts can substantially contribute to the data quality assurance effort, even if undertaken outside the context of the DQE team. It is important to contact and involve the functional data stewards and functional, technical, and data experts who work with the data or are in the process every day. The DQE team must depend on them to identify causes of problems with their data and solutions or opportunities for improvements. People will contribute most when they are responsible for something. Therefore, if these individuals recognize that quality is their responsibility every day, it will become easy to accept the importance of being involved and providing resources necessary to improve data quality. The DQE team has a responsibility to encourage each individual to contribute, recognize each contribution, no matter how small, and consult with every individual as appropriate. The goal is to develop a climate for each DQE effort in which people are increasingly willing to participate actively in the improvement activity.

4. Analyze Data Value Problems/Errors To Identify Root Cause Of Error. For each data value error category generated by the DQE tool, analysts determine a likely or probable root cause. The root cause analysis process begins with an assessment of the data in a very broad aspect. Remember to seek out true causes of problems and not on the symptoms. Some key questions to answer are: In what areas did a significant number of errors occur? Did a certain type of error occur with some frequency? What is the best area on which to concentrate efforts so as to get the biggest improvement in data quality? Analysis of errors that occurred on a more scattered basis will show the cause of the specific error, but may not identify a broad-based systematic problem. However, scattered errors should not be simply fixed on an individual basis and be forgotten. An across-the-board analysis of these errors may also be revealing. Based on this analysis, possible causes of the data value problem can be determined. The DQE team should examine the possible causes with several points of view. In determining the root cause, the DQE team should test and validate the possible causes. The Cause and Effect and Process Flow techniques can be used for identifying root causes. Possible causes should be classified into one or more of the four major problem categories: Process Problem, System Problem, Policy and Procedure Problem or Data Design Problem ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)).

a. Process Problem - Past experience has revealed that the majority of data error problems can be attributed to a process problem. For data errors categorized as process problems, effort is placed on analysis of existing process models, and using that knowledge base to find and recommend actions to correct the process fault.

b. System Problem - Data problems often stem from system design and use, particularly in the case of "legacy" systems. In the typical operation, legacy systems are meeting functional requirements in spite of numerous, poorly documented modifications. On careful examination, corrupt data values, data sources that are not clearly defined, the system being used to support requirements beyond the original intent, and a systems architecture that defines a system integration effort can usually be found.

c. Policy and Procedure Problem - An analysis of data value errors often reveals either conflicting guidance in current policy and procedure, lack of appropriate guidance, or a failure to comply with published policy/procedure.

d. Data Design Problem - There is also the potential that data models or standardized metadata will either need to be modified in order to correct what appear to be persistent relationship problems, or new data requirements actually developed in order to formally specify, document and standardize the appropriate data structures and uses.

e. Some data value errors cannot be attributed to a specific faulty process, system error or policy/procedure. The remedial action in such cases is to analyze the data error and determine the corrective action.

5. Develop Poor-Quality Cost (PQC) Baseline For Root Causes.

a. A Poor-Quality Cost (PQC) baseline must be established for the root causes in order to identify opportunities for improvement or to assess data quality improvements. PQC is defined as all of the costs incurred to create and maintain the data right every time and the cost of determining if the data values are acceptable, plus any cost incurred by the organization and the end-user because the data did not meet requirements and/or end-user expectations. The term PQC is appropriate because the baseline is designed to help identify and reduce the cost

associated with poor quality. Poor quality costs the DoD money. Good quality will save the DoD money. Therefore, cost baselines are not required for good quality data. The importance of PQC has already been recognized by DoD when a requirement for PQC systems was included in Military Standard MIL-Q-9858A ("Poor-Quality Cost", reference (s)).

b. In general, PQCs are categorized into four areas: prevention, appraisal, internal failure, and external failure. Once these costs are identified, there can be a better understanding of what the costs are, and funds can be targeted to the areas with the greatest potential for improvement and cost savings. The following sections describe procedures on how to establish the PQC baseline.

c. Determine Activity Costs. The PQC baseline provides a very useful tool to change the way both management and employees think about errors. In most companies, the activities that foster the costs of administrative errors and the resulting checks and balances are accepted as a way of life. Applying PQCs to these activities focuses management's attention on the activities that cause this neglected waste. An activity is a named process, function, or task that occurs over time and has recognizable results. Activities are considered the building blocks for assuring data quality. Therefore, it is essential to understand these activities in order to implement data quality improvement. The technique used in DoD for looking at activities and understanding them is called Activity Based Costing (ABC) ("Corporate Information Management, Process Improvement Methodology For DoD Functional Managers", reference (t)). ABC shows managers what they do with their money. Through the use of ABC, the DQE team must define the activities for data quality and determine the costs associated with these activities.

(1) Analyze Activities. ABC begins with identifying the activities that apply to managing the data. The scope of the activities to be analyzed should be based on the specific data elements where data errors occurred in the MEASURE activity. The identification of the activities is the most difficult tasks within ABC. The IDEF0 activity modeling technique provides a structured approach to the identification and analysis of the activities. The DQE team can use the activity model as a basis for interviewing key people associated with the business process and researching the accounting data, such as finding out the percentage of time involved in each activity. Through ABC, functional managers can characterize the value of, or need for, each activity. In turn, these characterizations can be used to rank activities for improvements.

(2) Determine Costs of Activities. Secondly, ABC identifies the costs that are associated with the different activities. This ability to match costs with activities quickly highlights where improvement is needed, whether one is determining long-term data quality improvement priorities, or measuring short-term success. Gathering the cost data can begin concurrently with the step, "analyze activities." Typically, historical costs are used for the initial baseline. Once the baseline is established, the selected improvement opportunity should include a plan for collecting current costs to update the PQC baseline. Costs are normally obtained from numerous existing records (e.g. financial reporting system, salary information, budgets, invoices). The costs may have to be estimated or calculated based on salary and level of effort information. The thrust of PQC should be to accumulate the total PQC figures. This allows for general assumptions that may have to be refined later during the improvement process. The PQC baseline is a management tool for improvement, and its use does not require precise costs.

d. Establish the PQC Baseline. The main types of PQC costs, depicted in Table 4-5 below, are direct PQCs and indirect PQCs ("Poor-Quality Cost", reference (s)). Direct PQCs include the costs the organization incurs because management is afraid that people will make mistakes, all of the costs incurred because data errors are detected, and the costs related to training people and maintaining systems so the data is managed effectively. Indirect PQCs are defined as those costs not directly measurable in the financial reports, but are part of PQC. They consist of three major categories: Customer-incurred PQC, Customer-dissatisfaction PQC, and Loss-of-reputation PQC. The PQC baseline should primarily focus on the direct PQCs. Direct PQCs are better understood, are traditionally used by management to run the business, and the results are less subjective. Also, the direct costs are usually found in financial reports where they can be verified. However the indirect PQCs should be identified wherever possible. DoD organizations must consider the impact of poor quality data on their customer (e.g. the Warfighter).

DIRECT POOR-QUALITY COSTS	INDIRECT POOR-QUALITY COSTS
A. Controllable poor-quality cost 1. Prevention cost 2. Appraisal cost	A. Customer-incurred cost
B. Resultant poor-quality cost 1. Internal error cost 2. External error cost	B. Customer-dissatisfaction cost
C. Equipment poor quality cost	C. Loss-of-reputation cost

Table 4-5 Type of Poor-Quality Cost

(1) Classify Activities into Direct PQCs. Once the activity based costs are established, differentiate the activity costs between operational (business) costs and quality activity costs (i.e. differentiate the activities that are done to ensure the quality of the products from the operational activities). Quality activities should be classified into the direct PQC categories. Direct PQCs encompass three major types of expenditures: Controllable PQCs, Resultant PQCs and Equipment PQCs. Controllable PQCs are those that management have direct control over to ensure that only end-user acceptable data are delivered to the end-user. Controllable costs are considered prevention and appraisal cost. Resultant PQCs (i.e. losses) include all incurred costs that result from the errors and are directly related to the controllable PQC category. This includes the money spent because the data was not created or maintained right. The resultant costs are considered internal failure costs and external failure costs. Equipment PQCs include the investment in the DQE tools used to define, measure, analyze, or improve the data, plus the cost of the space that equipment occupies. This includes the cost of the equipment used to print and report quality assessment data. Table 4-6 depicts example activity costs components for these areas ("Poor-Quality Cost", reference (s)). There are times where one activity may span more than one area. In this case, indicate a percentage of the activities cost in the appropriate cost category.

(3) Calculate PQC Baseline Data. Once the activities have been categorized into one or more of the direct PQC areas, then cost data in each category should be tallied, and used to calculate the cost baseline. Calculating the cost baseline, entails

understanding how the PQC elements interact with one another. The overall objectives for any data quality assurance program are to reduce the number of data errors, reduce the resultant costs (i.e. internal and external failure costs) and to reduce the overall costs of quality activities. But, in order to obtain these objectives, the controllable costs (prevention and appraisal costs) will need to fluctuate. The quality baseline can be depicted from various angles. Figure 4-2 illustrates the interaction between the cost elements versus time as one example of this ("Poor-Quality Cost", reference (s)). When the organization begins performing appraisals, the appraisal cost will rise due to setting up the measurement system. As the appraisals are conducted the external failure costs will begin to decline because less errors will be delivered to the end-user; but, the internal failure costs will begin to fluctuate up and down as part of the continuous improvement cycle (i.e. when new errors are detected and corrective actions are taken to resolve the root causes). As improvement projects are implemented, the prevention costs should begin to rise; but, as the data quality is improved the appraisal costs and internal costs will begin to decline because the need to measure will be replaced by improved systems, processes, policies, and data design. Overall, the total cost of quality begin to decline. PQC will never drop to zero because some prevention activities should always be performed and some appraisal activities will be needed to provide management with data quality assurances. The PQC baseline can also be represented as cost versus the number of errors. Figure 4-3 depicts the effect of the prevention cost on the total number of errors and the total error cost ("Poor-Quality Cost", reference (s)). Finally, the baseline data should be reported in a tabular or graphical representation in the Data Quality Baseline Assessment Report. (See Appendix B for the content outline of a Data Quality Baseline Assessment Report.)

e. This cost baseline is not intended to be completely accurate, but rather an estimate of costs to indicate and understand the costs of poor quality. The cost baseline is not a financial report that will be audited. It is a trend and magnitude indicator. It's purpose is to define major problem areas and to get management's attention. Therefore it is not intended to be 100% accurate; in fact, a good way to kill a quality program is to insist on an absolutely accurate baseline. A cost baseline that is 80% accurate may serve the purpose as long as it is constant and covers the major activities. With PQC reporting, consistency is the most important factor.

CONTROLLABLE COSTS		RESULTANT COSTS	
PREVENTION	APPRAISAL	INTERNAL FAILURE	EXTERNAL FAILURE
Training Costs Quality Planning Quality Assurance Data Entry Process Improvements Procedure Preparation System Maintenance Configuration Management Building Generalized Application Modules, Reusable Code	Quality Audits Monitoring Improvements Testing Hardware and Software Inspection of Purchased Items Quality Analysis Quality Assurance Data Processing Installation Testing Quality Data Collection and Analysis Operations System Assurance Reviews Preparation for Testing	Scrap and Rework Overtime, Idle Time Malfunction and Rerun Costs, Domino Effect From Failure Retesting Failure Analysis Corrective Actions to: - Data Values - Process - System - Documentation Productivity Loss	Complaints, Rebates, Damage Claims Lost Management Time Lost Business, Customer Affairs, Customer Goodwill Cost to Customer Due to the Failure Costs Indirectly Impacted From Failure Lost Opportunity Unrealized Savings Incorrect Decisions Based on Wrong Information Security Exposure Losses Legal Exposure Losses Lost Assets

Table 4-6 Examples of Indirect PQCs

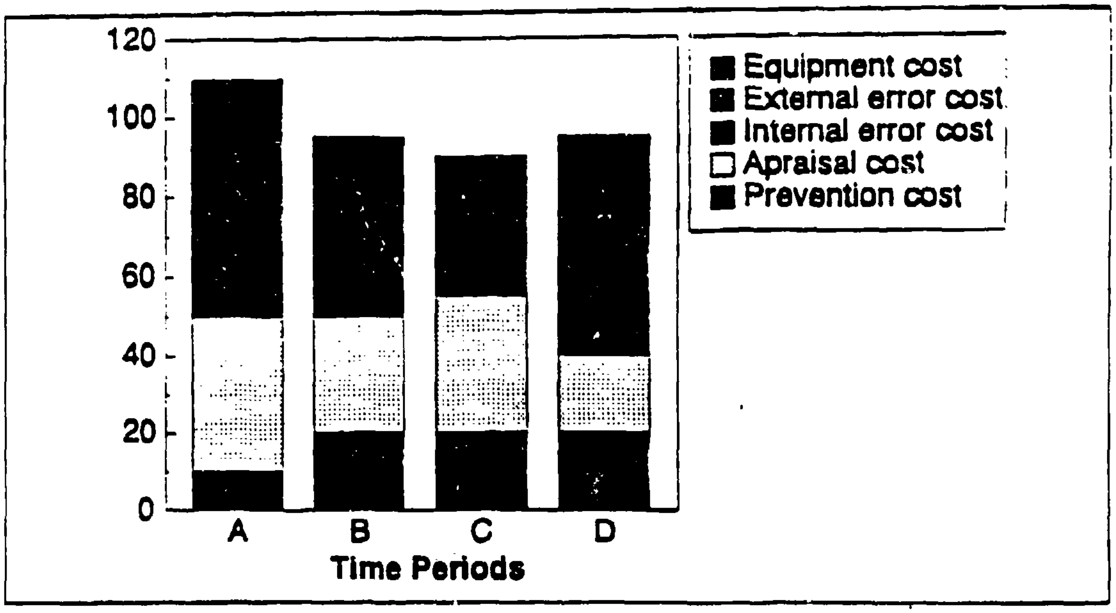


Figure 4-2 Effects of Modifying Controllable Poor-Quality Costs on the Same Data

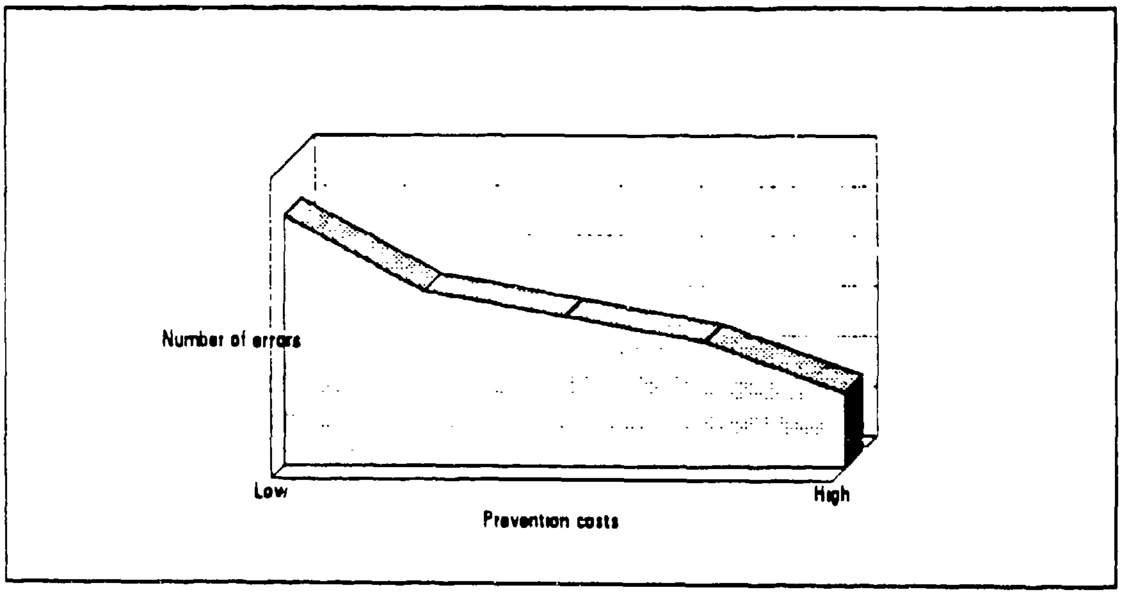


Figure 4-3 Effect of Prevention Costs on the Total Number of Errors

6. Determine Recommended Solution Alternatives and Improvements for Root Causes.

a. This is where the objective of the ANALYZE step is actually met and the drive for improvement begins. The prior steps, including measuring, identifying root cause, and establishing a PQC baseline should have helped the team to get an overall picture of the data quality problems. The results should not be looked at negatively or as indications of failure. Problems provide a chance for improvement and serve as gold mines for potential savings. Acknowledging problems and rewarding those who bring problems to light is an essential part of the data quality assurance process.

b. The DQE team should look at emergent or long-term problems for potential improvement projects. For each root cause, the DQE team will need to analyze the data quality baseline data, the root causes and the PQC baseline to determine recommended solutions. Innovative thinking should be encouraged in order to come up with cost effective new ideas. The end-user should be consulted for often times they have already considered or suggested possible solutions. Small incremental improvement ideas are favored for they are usually quick and easy to implement. If several recommended alternatives are available, use the quality and cost baselines to justify the feasibility of each recommendation. Data quality baselines are useful for identifying solutions whereby the least amount of effort can be expended to reduce the most number of errors. The PQC baseline is useful for determining the least amount of money that can be expended to reduce the most number of errors. The cost baseline is also a good tool for justifying the need to spend more money on controllable activities (i.e. prevention and appraisal costs). Sometimes, the only solution is to identify new or modified data requirements. If so, the metadata solution will have to comply with DoD 8320.1-M-1 (reference (k)) rules for data element standardization.

F. IMPROVE

1. The purpose of the IMPROVE activity is to implement improvement initiatives for correcting and further preventing data defects. The objectives of the steps are to select the recommended solutions and improvement alternatives, plan for improvement, implement solutions, check for improvement, and act to institutionalize the improvements. The steps, tools, and techniques of the IMPROVE activity are presented in Table 4-7 below.

OBJECTIVES	IMPROVE ACTIVITY STEPS	TOOLS/ TECHNIQUES
Implement improvement initiatives for correcting and further preventing data defects.	1. Formally Provide Recommended Improvement Alternatives and Corrective Actions 2. Select Improvement Opportunity and Decide on Corrective Action 3. Implement Selected Improvement Opportunity, Take Corrective Action and/or Respond To Recommendations 4. Monitor Implementation and Corrective Action Progress 5. Validate and Document Improved Data Quality	Cost of Quality QFD DTR Pareto Chart Histogram DQE Tool Cause & Effect Process Flow

Table 4-7 DoD DQE IMPROVE Activity

1. <u>Formally Provide Recommended Improvement Alternatives and Corrective Actions</u>. In order to provide recommended improvement alternatives, the DQE team must set the stage for improvement. Fortunately, the individuals that are ultimately responsible for implementing the recommendations were involved in the ANALYZE activity and participated in preparing the recommendations. Setting the stage requires the support of these same individuals and their management. The DQE team must formally provide recommended improvement alternatives to one or all of the following (when applicable): data stewards, Functional Activity Program Managers (FAPM), Automated Information Systems Program Managers (AIS PM), and users depending on the type of problem (i.e. system, process, procedure or data design). Regardless of the type of problem, the data value error should be formally documented and provided to the source file data steward or DBAd for immediate corrective action. The documentation should identify: where the error occurred (e.g. file, record, field, name), why it occurred (compare with business rules), and the probable correction with cost/impact statement.

2. Select Improvement Opportunity and Decide on Corrective Action. The individual receiving the recommendation should select an improvement opportunity. This involves reviewing the potential opportunities, prioritizing them, and choosing the solution that will impact the majority or all of the root causes and has the greatest potential for success. Other things to consider include how the solutions will affect end-users and the people actually involved in the process, the resources needed to accomplish the improvement, and the impact on the PQCs if the alternative is not selected. In addition to selecting an improvement opportunity to prevent further errors, a decision must be made on the immediate corrective action to be applied to the current data defect.

3. Implement Selected Improvement Opportunity, Take Corrective Action and/or Respond To Recommendations. If an improvement opportunity is selected, the individuals responsible for implementing the solution should quickly move to implement and properly document the solution. During implementation, it is important to ensure that applicable documentation are modified appropriately. Also, it is important to establish a process for detecting failures and monitoring improvements to ensure that the changes to the system, process, procedure, or data design have their desired lasting effect in accordance with the new standard. During this step, the current data defect is also corrected. The data steward or DBAd should notify the DQE team when the error is corrected. If a solution alternative or corrective action cannot be implemented, then an explanation and solution alternatives should be provided to the DQE team. The DQE team should document all implemented solutions, corrective actions taken, and explanations in the DQE Data Quality Baseline Assessment Report. (See Appendix B for the content outline of a Data Quality Baseline Assessment Report.)

4. Monitor Implementation and Corrective Action Progress. The DQE team must monitor implementation progress of all improvement opportunities and corrective actions to data values. The Data Trouble Reports (DTRs) are useful for monitoring corrective actions, documenting what, when, and by whom corrective actions were taken or documenting explanations of why the corrective actions were not taken. An improvement opportunity may take longer to implement than the time allotted for the DQE project due to the time needed to get plans approved and to allocate resources. In this case, the DQE team may assign individuals to follow up on the improvements periodically. Although implementing the solution is near the end of the DQE project, the DQE team must also continue to monitor the solution to ensure it remains effective. This is why, future data collection and measurement techniques must be built into the implementation plan. Also, eventually, specific quality assurance activities will be eliminated from the functional processes due to improvements, and the overall quality improvement cycle will continue forever, without end.

5. Validate and Document Improved Data Quality. The DQE team must reassess the data to determine how well the actual performance matches the planned improvements. Tracking the effectiveness of improvement efforts is actually considered a part of the measurement and analysis efforts. It includes re-calculating the metrics to validate data quality improvement results to establish a new data quality baseline and calculating a new PQC baseline to show a reduction in costs and a return on investments for data quality assurance. After the improvement and/or corrective actions are validated, the DQE team should document any improved data quality, reduced costs and the DQE performance data thoroughly in the Data Quality Baseline Assessment Report. But, often times the new source data values cannot be obtained until after the improvement opportunity has had ample time to be affective. Sometimes this time period is longer then the planned DQE project timeframe. In this case, the DQE team should conduct a trial implementation on the suspect data to simulate the effect the improvement will have overall. New or predicted baselines should be used to justify making the improvement solution permanent and for recommending follow-up actions or subsequent improvement efforts. Documenting data quality improvements allows others to benefit from the lessons learned and gains recognition for data quality assurance and DAdm.

G. VALUE OF THE DoD DQE METHODOLOGY

1. Past results have shown that the DoD DQE methodology can be used to improve data quality, these improvements can be measured, and processes can be put in place to continuously monitor and further improve DoD data quality. As a result, migration toward standards-compliant systems can be simplified and the cost of developing new systems or maintaining existing ones is reduced. One of the important features of the DoD DQE methodology is that measures of effectiveness are built into the process so it is possible to measure what is being managed.

2. Data quality engineering supports the data migration strategies outlined in the three-phase functional management process strategy for the management of DoD information (DoD 8320.1-M, reference (q)). Phase 1 is the establishment of a functional architecture and a strategy for meeting functional requirements. Phase 2 is the establishment of baselines for process, data, and information systems. This phase entails selecting information systems, which are then designated "migration systems," to support existing business processes. Phase 3 is the improvement of functions, data, and information systems. This phase entails business process reengineering and information technology enhancement.

3. The products from the DoD DQE methodology support both Phase 2 and Phase 3 of the functional management process. In Phase 2, the data quality baselines are used to measure migration potential for legacy applications and selecting migration systems. In Phase 3, the products of the DQE methodology are used to

a. identify opportunities for functional process improvement,

b. improve the quality of existing legacy data,

c. build data quality requirements into new target systems,

d. identify the best data source from which to populate target systems, and

e. develop a migration strategy for converting legacy data values to standard data structures.

4. The enforcement of data quality standards using DQE is vital for establishing and maintaining the credibility of DoD data. Poor quality data can be an expensive deterrent to cross-functional and cross-system integration.

CHAPTER 5

TOOLS AND TECHNIQUES

A. INTRODUCTION

1. This section identifies tools and techniques for the detection and correction of data errors. These tools and techniques support the Total Data Quality Management (TDQM) process and the DoD Data Quality Engineering (DQE) methodology. Also, this chapter will address detection and correction techniques to be done in the analysis phase.

B. TOOLS AND TECHNIQUES

1. This section provides additional guidance on the use of the generic tools and techniques that were identified to support the TDQM process and the DoD DQE methodology. They are representative of the tools that are used to improve any process and are presented here to provide awareness of the different tools and techniques available, when to use them, and how to use them. Other sources should be consulted to obtain in-depth information concerning these tools and techniques.

2. There are a number of factors that may lead to the decision for using a particular tool or set of tools, including the individual/DQE team experience and preferences. Most tools are oriented to a certain type of activity, as identified in the previous Chapters of this Manual. Table 5-1 summarizes the identified tools and techniques to support the TDQM process, including the DoD DQE methodology, and the Steps in which the tools and techniques are used.

Tools & Techniques	DoD DQE Methodology			
	Define	Measure	Analyze	Improve
1. DDRS	✓	✓	✓	
2. Data Selection Evaluation	✓			
3. Data Model	✓	✓	✓	
4. Activity Model	✓		✓	
5. Nominal Group Technique	✓		✓	
6. Cost Of Quality	✓		✓	✓
7. Quality Function Deployment	✓			✓
8. Benchmarking		✓		
9. Control Chart	✓	✓	✓	
10. Data Trouble Report	✓	✓	✓	✓
11. Pareto Chart	✓	✓	✓	✓
12. Histograms	✓	✓	✓	✓
13. DQE Automated Tool		✓	✓	✓
14. Checksheets		✓	✓	
15. Cause & Effect			✓	✓
16. Process Flow Analysis			✓	✓

Table 5-1 DoD TDQM Tools and Techniques

1. DoD Defense Data Repository System (DDRS). The DoD DDRS was implemented in the Department of Defense in response to the DoD Directive 8320.1, Data Administration, dated September 26, 1991 (reference (a)). DoD Directive 8320.1, Data Administration, mandates the development, operation, and maintenance of a repository system as a primary tool of DoD DAdm. The DDRS is a centralized repository of information about DoD data which is accessible to DoD Components and users. It is a centrally controlled DoD-wide data repository that manages and stores information about data such as meaning, relationships to other data, origin, usage, and format. Additionally, the DoD DDRS is the tool used to standardize data.

a. There are specifically documented objectives for the DDRS. These objectives state that the DDRS collects and stores information about DoD Standard Data Elements, Generic Elements, and Non-Standard Data Elements (migration data elements).

b. This information includes data about each of these elements. Data includes the element's metadata (characteristics of the element). In addition to metadata about the element, the DDRS also maintains information on users of the DDRS as well as information on users of DoD Standard Data Elements.

c. Another objective of the DDRS is to track and monitor the status of an element (DoD Standard Data Element or Generic Element) through its standardization phases from development to an approved element to an archived element. All modifications made to an element during its standardization phases are maintained and stored in the DDRS.

d. A third objective of the DDRS is to use it as a standardization tool to progress the Standard Data Element and Generic Element through the standardization phases.

e. A fourth objective is to provide the DDRS as a DoD-wide accessible, on-line standardization tool for use in creating and modifying elements, and then querying and reporting on data stored in the DDRS. As the DDRS becomes more accessible to the DoD user community, it will become increasingly more valuable to the DoD data quality assurance program for defining data elements. If there is a new data requirement, the DDRS Develop Element functions are used to develop new Standard Data Elements and/or Generic Elements.

2. Data Selection Evaluation Technique. When identifying a data quality project, many criteria should be reviewed to determine the suitability of the project. Prior to the evaluation and selection of data for data quality improvement (whether an initial effort or a prototype effort) a set of selection criteria must be developed. Major evaluation areas should be identified and selection criteria are to be developed for each area. The evaluation areas should focus on the availability of information needed for the DoD DQE process detailed in Step 3. Criteria and weighting factors should be applied to evaluate, select, and perform the DoD DQE analysis. The score for each criteria should range from 0 to 10, with the highest scores indicating the data that best meets the preferred outcome for each criteria. The evaluation areas should address: access to data; documentation completeness; adequacy; availability; access to author; access to functional and technical data experts, and system data quality history ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)). Examples of Data Selection Criteria evaluation factors to be considered are developed in Table 5-2.

a. It is critical to evaluate the system and identify the system as a legacy or migration system. This will determine what stage of the AIS life-cycle data quality improvement development efforts will occur.

Data Selection Criteria		
Criteria	**Weight**	**Description**
Access To Data		
Media for Download		Is media for data download tape, disk, or electronic? Is media conversion required to use data with DoD DQE tool? Is data formatted in ASCII or a database format? 1600 bpi tape in ASCII format preferred.
Existing Download vs. Custom Download		Is there an existing extract program or operating system utility available for download or must a custom download program be developed? No program development preferred.
Unrestricted Access to Data		Are there restriction on the provision or use of the data? No restrictions are preferred.
Cost of Data Retrieval		Is there cost associated with the download and provision of the data? No cost is preferred.
Authoritative Source Identifiable		Is there an authoritative source for metadata and data correctness for use in resolving conflicts in data definitions and values during DoD DQE analysis? An identifiable and available authoritative source is preferred.
Nonclassified / Nonsensitive		Is the data classified or sensitive? Nonclassified and nonsensitive data is preferred.
Data Well-structured - No Multiple Concepts/Uses		Are the data structures clearly defined and used consistently across the applications? Single use concepts and clearly defined structures are preferred.

Table 5-2 DoD DQE Data Selection Criteria

Data Selection Criteria		
Criteria	Weight	Description
Current Documentation (completeness, adequacy, availability, author) (For all documents current, complete, well structured, available documentation with access to the document author is preferred.)		
Data Element Dictionary (DED)		What is the status and contents of the DED?
Database Specification		What is the status of the Database Specification for the system?
Data Model (logical and physical)		What is the status of the logical and physical data models for the system?
Business Rules		What is the status of the business rules that apply to the processing of the system data?
Process Model		What is the status of the process model for the activities that he system supports?
System Functional Description		What is the status of the system functional description?
System Design Specifications Author		What is the status of the system design specifications? Is the author available for consultation?
Orders and Regulations		What is the status of the orders and regulations that apply to the definition and use of the system data?

Table 5-2 DoD DQE Data Selection Criteria (continued)

Data Selection Criteria		
Criteria	**Weight**	**Description**
Access To Functional Experts		
Location of Experts		Are system functional experts within the local travel area or is long distance travel required to obtain face-to-face support when necessary? Local area is preferred.
Willingness to Cooperate		Are the functional experts available during the period of performance for the DoD DQE project? Is there a willingness on the part of the functional experts and their organizations to participate in the DoD DQE project? Functional expert availability and willingness is preferred.
Political Roadblocks		Are there any obstacles in obtaining or that would delay participation by functional experts, such as organizational, financial, or contractual, policy conflicts? No obstacles are preferred.
Access To Technical Experts		
Location of Experts		Are system technical experts within the local travel area or is long distance travel required to obtain face-to-face support when necessary? Local area is preferred.
Willingness to Cooperate		Are the technical experts available during the period of performance for the DoD DQE project? Is there a willingness on the part of the technical experts and their organizations to participate in the DoD DQE project? Technical expert availability and willingness is preferred.
Political Roadblocks		Are there any obstacles in obtaining or that would delay participation by technical experts, such as organizational, financial, contractual, or policy conflicts? No obstacles are preferred.

Table 5-2 DoD DQE Data Selection Criteria (continued)

Data Selection Criteria		
Criteria	**Weight**	**Description**
		Data Background
Historical Data Quality Problems		Are there any known data quality problems associated with the systems that would assist in focusing the DoD DQE analysis? Clearly identified historical data problems are preferred.
Criticality to Organization		How critical is the systems and its data to the using organization? Organizations with highly critical data would be expected to have greater interest in participating in the DoD DQE project. Also, highly critical systems would be expected to have more rigorous data edits. Highly critical data is preferred.
Opportunity to Demonstrate DoD DQE Methodology in a New Environment		Is the DoD DQE methodology being demonstrated on a non-Marine Corps system? DoD DQE was developed in the Marine Corp environment. Demonstration of the DoD DQE methodology on a non-Marine Corps system is preferred.
		Data Environment
Government Ownership		Is the system and the data owned by the Government or are there contractor proprietary rights on the system or data? Fully Government owned systems and data are preferred.
Can Be Scoped to "Double" Size		Are the data structures well-defined and segmentable so that the DoD DQE project can be sized to meet the time restraints? Well-defined, segmentable data structures are preferred. (For prototype efforts, the effort should take no more than 30-60 days to complete.)

Table 5-2 DoD DQE Data Selection Criteria (continued)

Data Selection Criteria		
Criteria	**Weight**	**Description**
Data Environment (continued)		
Good Cost Reporting - Can Identity and Reduce Quality Costs		Can the quality or lack of quality of the system's data be sufficiently defined in financial terms to show the potential cost savings that could result from a DoD DQE analysis of the entire system? Clear identification of the value of quality data is preferred.
Opportunity for Other Metrics Assessment		Does the system and data offer the opportunity to define additional data quality metrics or expand the applicability of DoD DQE? Expansion opportunities are preferred.
Active Data Administration Program		Is there an active data administration program in the organization that manages and supports the system? An active data administration program is preferred.
Low Risk		What is the risk of meeting the objectives of the DoD DQE project within the allotted schedule and cost using the designate system? Low risk is preferred.
High Payoff		What is the potential level of benefit of conducting the DoD DQE methodology on the designated system and the system owner? High level of benefit is preferred.

Table 5-2 DoD DQE Data Selection Criteria (continued)

3. Data Model. A data model is defined as "in a database, the user's logical view of the data in contrast to the physically stored data, or storage structure; a description of the organization of data in a manner that reflects the information structure of an enterprise" (DoD 8320.1-M, reference (d)).

4. Activity Model. An activity model is defined as "models of the processes that make up the functional activity showing inputs, outputs, controls, and mechanisms through which the processes of the functional activity are (or will be) conducted" (DoD 8320.1-M, reference (d)).

5. Nominal Group Technique (NGT). The NGT is a good team development tool especially with new teams that may be cautious about disclosing opinions and ideas. The NGT is a variation of "brainstorming" and generates ideas and creates team energy. A "brainstorming" activity helps unlock the creativity of a group and is more effective than trying to generate ideas as individuals. Brainstorming is a group activity that is used to stimulate ideas, such as possible problems, causes of problems, or solutions to problems. The NGT is a variation of brainstorming. In brainstorming, ideas are generated aloud through a round-robin technique ("Teams for Excellence: Skills, Strategies & Implementation Exercise Book", reference (r)). In the NGT, the group generates individual lists first and then combines the lists.

a. More specifically, the guidelines for performing the NGT include:

- Identify a Topic
- Each Team Member Creates A List Of Ideas
- Each Team Member Reads The List Aloud To The Group
- A Master List Of Ideas Is Created
- The Group Analyzes The Master List
- Condense and Rank The List By Voting
- The Team Takes Action On The Highest-Ranking Items (Or Implements The Highest Ranking Ideas

6. Cost of Quality. A data quality baseline is needed as a starting point for data quality improvement. A baseline is a set of information metrics expressed in some form or model. Activities are the building blocks of building data quality assurance. Therefore, it is essential to understand these activities to implement data quality improvement. The technique used in DoD for looking at activities and understanding them is called Activity Based Costing (ABC).

Through the use of ABC, activities for data quality can be defined (activities under the categories of Prevention, Appraisal, Internal Failure and External Failure) and costs based on or associated with these activities can be determined. ABC shows managers what they do with their money ("Corporate Information Management, Process Improvement Methodology For DoD Functional Managers", reference (t)).

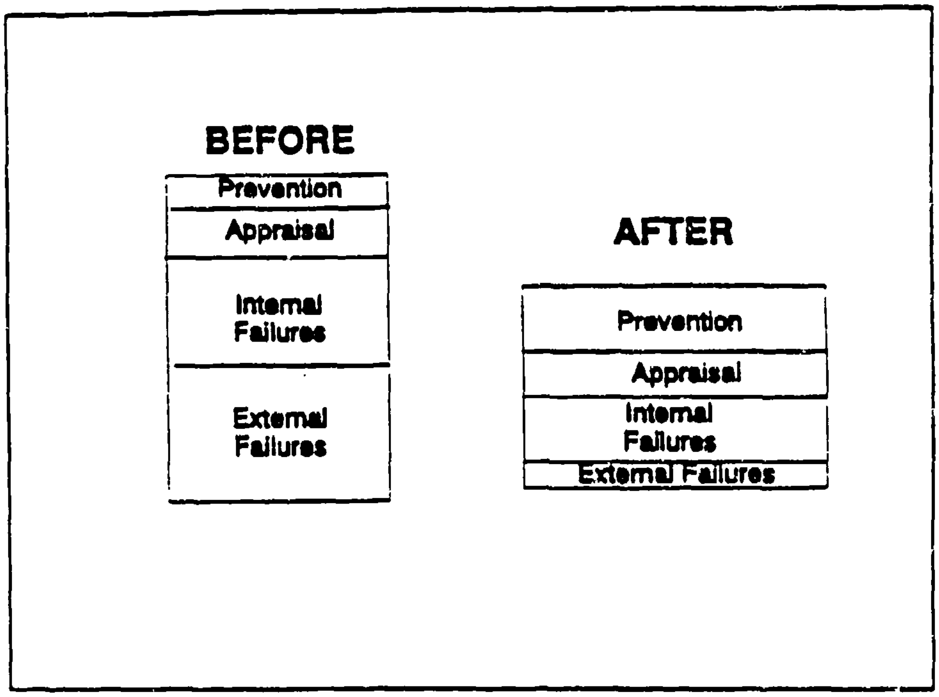


Figure 5-1 Cost of Quality

a. This ability to match costs with activities quickly highlights where improvement is needed, whether one is determining long-term data quality improvement priorities, or measuring short-term success. Through ABC, functional managers can characterize the value of, or need for, each activity. In turn, these characterizations can be used to rank activities for improvements.

b. In general, creating a cost baseline includes first identifying the activities that apply to managing data. Second, identify the costs of data quality that are associated with the different activities that apply to managing the data.

c. More specifically, first identify all of the quality cost elements, under each category, related to the data under analysis. Once the cost-elements list is completed, each element should be classified. Costs must first be differentiated between operational (business) costs and costs of quality. Costs of quality are identified as being Prevention Costs, Appraisal Costs, Internal Costs, and External Costs.

7. Quality Function Deployment (QFD). The QFD technique is a conceptual map that provides the means for cross-functional planning and communications. It is a method for transforming customer wants and needs into quantitative, engineering terms. When developing a QFD, the following questions need to be asked: (1) What data attributes are desired?, (2) Are all attributes equally important?, (3) What are the engineering characteristics that match the data attributes?, (4) How does each engineering characteristic affect each data attribute?, and (5) How does one engineering change affect other characteristics? (DoD 5000.51-G, reference (o)).

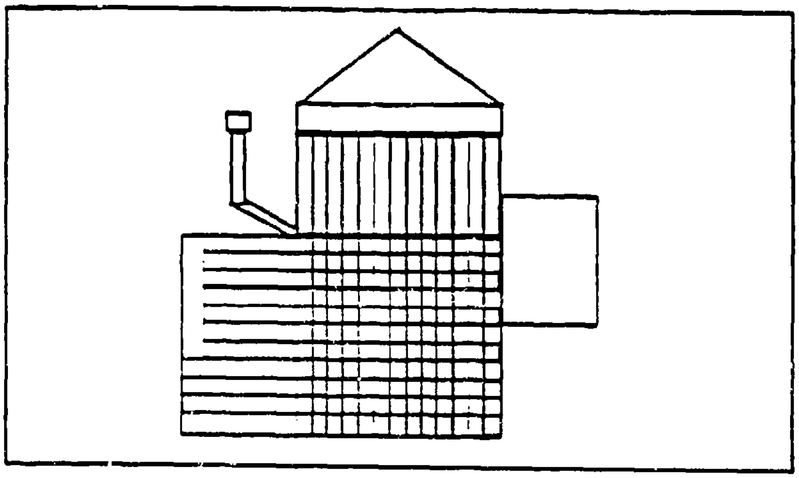


Figure 5-2 Quality Function Deployment

8. Benchmarking. Benchmarking is a method of measuring processes against those of recognized performance. It helps to establish priorities and targets leading to process improvement. By understanding where the current level of performance is in comparison to other identified levels of performance allows for gauging performance. When performance is measured against other "benchmarks" various processes for improvement can be targeted (DoD 5000.51-G, reference (o)).

9. Control Charts. Control Charts are a graphic representation of measured actual performance relative to computed control limits. They are used to show the variation on process variables and identify special causes. This technique allows the distinction between measurements that are predictably within the inherent capability of the process (common causes of variation) and measurements that are unpredictable and produced by special causes (DoD 5000.51-G, reference (o)).

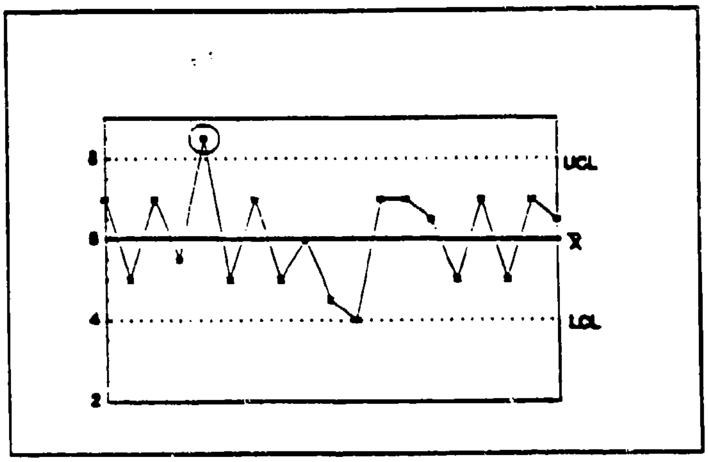


Figure 5-3 Control Charts

10. DataTrouble Report (DTR). A DTR includes creating a standard form for documenting and improving data quality problems. The form should include the following information topics: (1) Define The Problem, (2) Analysis of Problem, (3) Determine Causes, (3) Action Taken to Eliminate Cause, (4) Validating The Solution, and (4) Improvement Recommendations.

11. Pareto Chart. A Pareto Chart is a special form of vertical bar graph which helps determine which problems to solve in what order. This bar graph arranges bars in descending order, with the largest to the left. Each bar represents a problem. The chart displays the relative contribution of each sub-problem to the total problem. Doing a Pareto Chart based upon either Check Sheets or other forms of data collection helps direct attention and efforts to the important problems. In general, more is gained from working on the tallest bar (e.g.,the most detected data errors) than on the smaller bars. The basic steps on creating a Pareto Chart are: (1) Select the problems that are to be compared and rank order, (2) Select the standard for comparison unit of measurement, (3) Select time period to be studied, (4) Gather the necessary data on each category, (5) Compare the frequency or cost of each category relative to all other categories, (6) List the categories from left to right on the horizontal axis in their order of decreasing frequency or costs, (7) Above each classification or category, draw a rectangle whose height represents the frequency or cost in that classification (DoD 5000.51-G, reference (o)).

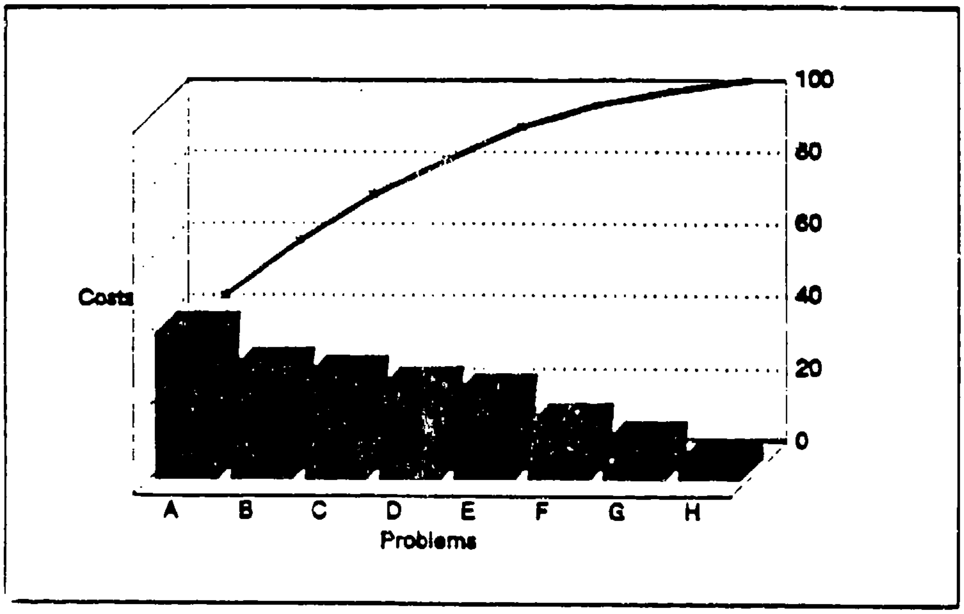


Figure 5-4 Pareto Chart

12. Histograms. A Histograms is a graph that displays frequency of data in a column form. A Histogram takes measurement data and displays its distribution. This helps to identify changes or shifts in data or in processes as changes are made. It shows how variable measurements of a process or data errors can be, and it helps in the establishment of baselines. Once baselines have been set, measurements can be compared to these standards. The basic steps for construction a Histogram are: (1) Determine the measurements to be taken, (2) Collect data, (3) Organize data into incremental units, and (4) Develop a graph to pictorially summarize the results (DoD 5000.51-G, reference (o)).

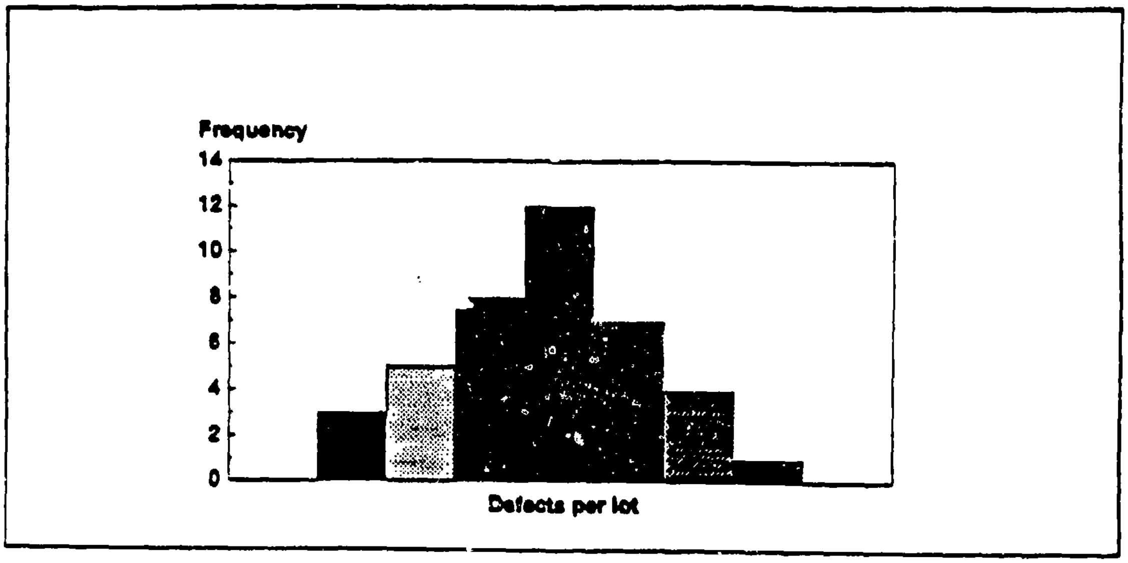


Figure 5-5 Histogram

13. <u>DQE Automated Tool</u>. The DQE automated tool is used to (1) assess the accuracy, validity, and usefulness of actual data values, and to (2) trigger the DAdm process for data validation and business process correction. The standards information derived during data analysis, modeling, and standardization is used to develop automated rule sets to check actual data values and associated metadata for accuracy and consistency. For example, standard code tables are used as the foundation for domain checks, and the relationships defined in data models are translated into operational rule sets. The DQE tool performs zero and blank checking, mathematical calculations, operational rule set validation, and statistical tests and validation to check data values for accuracy and consistency. The DQE tool permits continuous assessment of the progress made toward achieving total data quality ("Data Quality Engineering (DQE) Pilot Project, Technical Report, reference (p)).

a. In the DQE methodology, data analyses is performed on individual data elements to determine the quality requirements. The requirements are used to generate rule sets which provide the foundation for specific data quality engineering routines to be constructed within a data quality tool. A data quality tool executes the routines to perform data quality assessments on each data element analyzed. Some types of data quality checks performed by tools are: searches for unqualified blank or zero data values, duplicate records (based on key field comparisons), and invalid domains/ranges. Checks are performed to detect errors by comparing a given data value to a calculated value using related data in a given record or database. Also, data values are subject to checks based on operationally oriented (if...then) rule sets.

b. A data quality tool should be "data-driven" to allow for easy modification to work with virtually any type of data or any combination of databases and to perform any type of quality check. It should also have the capability to be configured and controlled without the support from programmers or system analysts. The tool should produce a definitive list of data errors and, often predict correct data values. The tool should automatically find and flag data errors and include a means for tracking data error corrections and providing the DAd with a means of automatically generating metric reports in graphic and table formats.

14. <u>Checksheets</u> also facilitate data collection by providing a standardized format for recording information. Checksheets include a list of check-off items that permit data to be collected quickly and easily in a simple standardized format that lends itself to quantitative analysis. Checksheets are frequently used to collect data on the number of defects/errors identified. Checksheets are conducted by (1) Identifying the data to be collected, (2) Designing a Checksheet to collect data, (3) Collecting the data, and (4) Tabulating results (DoD 5000.51-G, reference (o)).

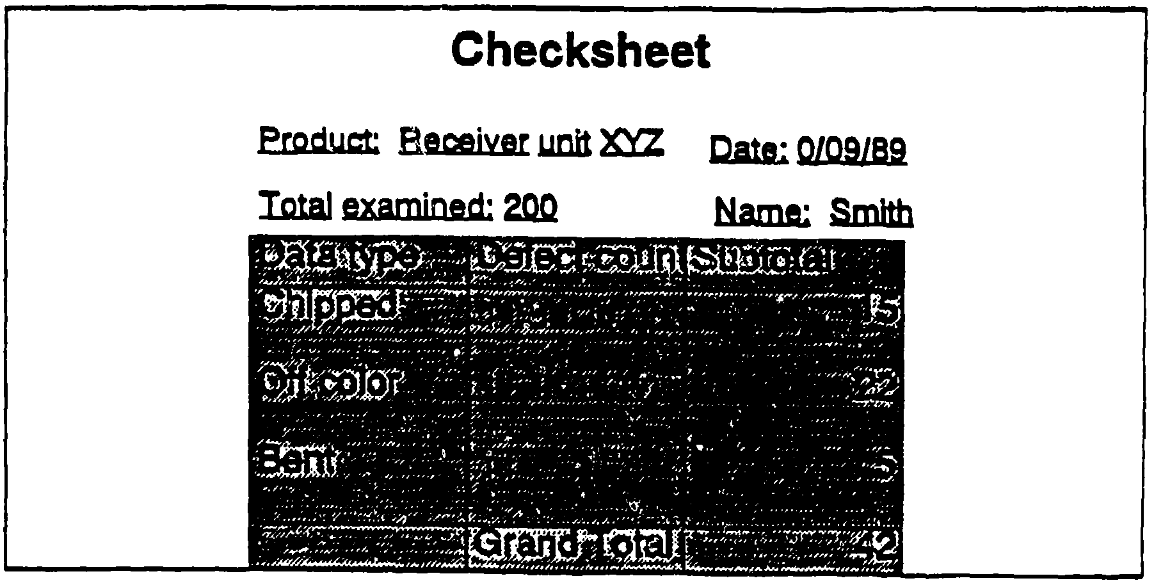


Figure 5-6 Checksheet

15. Cause & Effect. The cause and effect diagram was developed to represent the relationship between some "effect" and all of the possible "causes" influencing it. The effect or problem is stated on the right side of the chart and the major influences or "causes" are listed to the left. Begin by trying to pick a problem that is controllable within the organization. The basic steps in creating a cause and effect include: (1) Naming the Problem, (2) Deciding on the major categories of causes, (3) Brainstorming for more detailed causes, (4) Eliminating causes that do not apply, (5) Discussing the remaining causes and decide which are most important, (6) Working on the most important causes, and (7) Eliminating or Correcting Causes (DoD 5000.51-G, reference (o)).

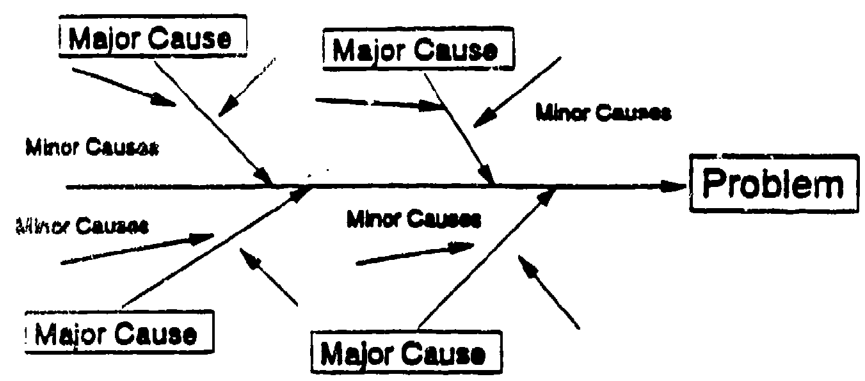


Figure 5-7 Cause & Effect

16. Process Flow Analysis. Process Flow Analysis is a structured system that documents all the steps in a work process or procedure and will identify areas where problems are prevalent and opportunities for improvement. It helps to improve a process by isolating the causes of problems or potential problems associated with the process. It is important to set the boundaries of the process that is to be analyzed, prior to this exercise. The guidelines for performing a Process Flow Analysis include (DoD 5000.51-G, reference (o)):

- Diagram The Process

- Have Team Members Identify The Procedures and Potential Problems That Can Occur In Each Stage Of The Process

- Analyze The Process

- Redesign The Process By Incorporating The Selected Ideas For Improvement

- Test The Process Changes

- Document The Process Changes

Process/Subprocess Steps	Step 1	Step 2	Step 3	Step 4	Etc.
Desired Performance					
Actual Performance					
Cause of Gap					
Recommended Change					

Figure 5-8 Work Flow Analysis

APPENDICES

APPENDIX A

DATA RESOURCES MANAGEMENT AND STANDARDIZATION PROGRAM

DC/S Installations & Logistics
Headquarters, U.S. Marine Corps

Description of the Data Resources Management and Standardization Program

The Data Resources Management and Standardization Program (DRM&S) began on February 11, 1991. The principal objective of the DRM&S program was to supply accurate, valid, and reliable data to Marine Corps logistics planners. DRM&S developed a Data Quality Engineering (DQE) program as a means of enhancing the quality of source data files used by the Marine Air Ground Task Force Logistics Automated Information Systems (MAGTF II/LOG AIS) family of PC-based logistics systems, used for planning, deployment, employment and sustainment. The program continues to achieve this objective by developing and enforcing data standards, finding and correcting data errors, and, finally, identifying and implementing needed functional process improvements. DRM&S developed the DQE methodology which encompasses the development and implementation of a series of steps to ensure accurate data. DRM&S used DQE to identify data errors and trigger appropriate corrections and process changes.

The DRM&S program was tasked to develop and field a system that facilitated logistics data administration. The DRM&S developed the Marine Air Ground Task Force Data Library (MDL) System to meet that requirement and to provide the means for achieving logistics data distribution and control. The MDL also served as the host for the automated data quality engineering tool used to achieve and maintain data quality.

The DQE tool is the principal function of the Marine Air Ground Task Force Data Library (MDL) System. The analyses provided the foundation on which specific data quality engineering routines were constructed within MDL. The knowledge acquired through these analyses allowed a system user to establish and modify the data quality controls implemented within the MDL system. Because the DQE tool is developed using object-oriented code, the program is transportable and readily adaptable to a variety of data file structures.

This case has been prepared to demonstrate a "real-life" application of the Data Quality Engineering (DQE) methodology to the DoD data environment (U.S. Marine Corps). The DQE tool of the MDL system is available for use throughout DoD through the Software Re-Use Program, Defense Software Repository System (DSRS). In 1992, the DRM&S were nominated for a Gold Nugget Award through the Defense Information Management Program.

The DRM&S implemented the DQE methodology as an integral part of their Data Administration process (see Figure A-1). The U.S. Marine Corps DQE methodology began with a comprehensive standardization process, supported by a suite of custom designed CASE tools. The data standardization process consisted of the following four inter-related analyses, which are described in Chapter 4 of this Manual:

- High-level Collision Analysis
- Collision Analysis
- Data Structure Analysis
- Domain and Range Analysis

The MDL system automatically performed DQE on each data element processed. Data quality routines included checks for unqualified blank or zero data values, duplicate records (based on key field comparisons), and invalid domains/ranges. When applicable, a data quality routing check for errors, by comparing a given data value to a calculated value using related data in a given record or database, was performed. Finally, data values were subject to checks based on operationally oriented (if...then) rule sets. MDL produced a definitive list of data errors and, often, predicted correct data values. The MDL systems automatically found and flagged data errors and triggered appropriate action from the DAd. Further, DQE often identified a probable correct value and, frequently, the likely source or causes of the problem. Finally, the MDL system included a means for tracking data error corrections and provided the DAd with a means of automatically generating progress report "metrics" in graphic and table formats.

Since the initial implementation of DQE in DRM&S, DQE has become an increasingly important component of the Marine Corps logistics data administration process. The DQE effort focused on finding and correcting problems with data availability, accuracy, validity, and reliability. A key feature of DQE lies in the use of preprogrammed, automated routines to check data values. Data value check routines vary in sophistication from a simple check for a missing or an inappropriate null-data value to use of a complex rule set. Using DQE principles, suspect data was quickly identified, categorized, and provided to DAds in a form that facilitated action by functionally oriented process action teams. In summary, DQE replaced vague complaints about "bad data" (with, at best, isolated examples) with a means of not only capturing specific errors, but triggering action to correct both the data and, when appropriate, a flawed process that resulted in the data error.

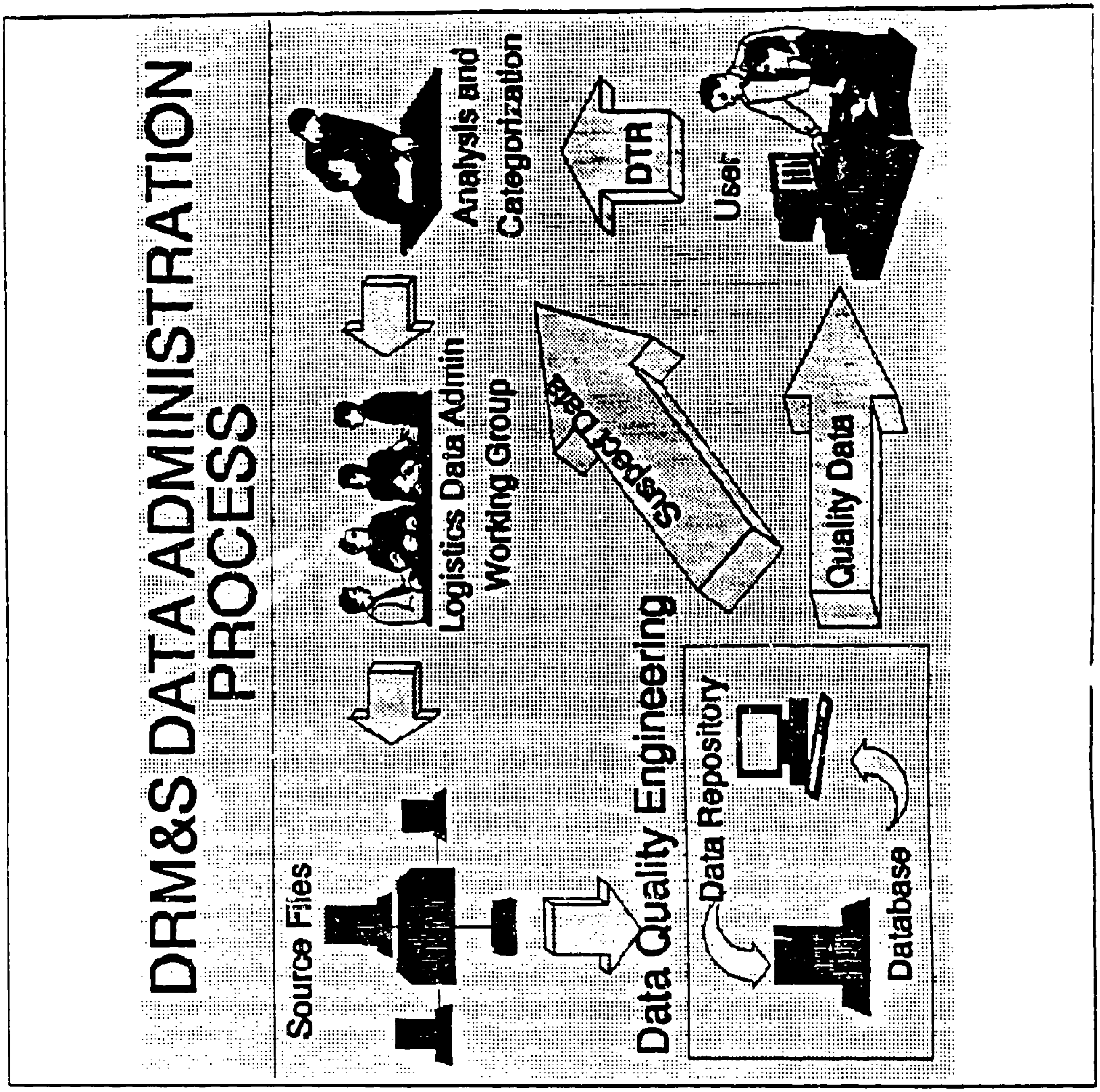


Figure A-1 DRM&S
Data Administration Process

To date, the DRM&S program has identified over 8,000 specific data errors in logistics data from legacy systems. Among many other statistics the DQE process revealed that 95% of errors were caused by faulty processes or procedures and not data-entry problems or computer/program malfunctions. By applying sound data administration practices, Marine Corps logistics planners have realized a 33% increase in the availability of accurate technical data, with further improvement occurring with each new data release. Finally, benefits of the DRM&S program included:

- Accurate, reliable, valid data.
- Elimination of multiple sources for similar data.
- Simplified data distribution schemes and improved data availability.
- Improved functional processes and procedures.

Sample Program Objectives and Accomplishments

The following three samples of work performed under the Data Resources Management and Standardization program have been selected to illustrate the success of the DQE effort.

<u>Sample 1 - New Standards for Data Quality</u>

Prior to the Data Resources Management and Standardization (DRM&S) program, the Marine Corps logistics DAd was aware that problems existed in data quality. While specific examples of "bad data" were not difficult to find the DAd's most pressing need was to establish an effective procedure for attacking all data errors and, where appropriate, the faulty data administration process. The DRM&S program provided the Marine Corps DAd with the tools needed to quantify data errors and to focus corrective action.

Figure A-2 depicts a typical data quality engineering product. This is an example analysis of six fields in the Item Description File (IDF), an important Marine Corps source file. As shown, the DQE process provides a unique insight into the data in the IDF. In this case, the DQE process included routines that:

- Reported the percentage of valid (not blank or zero) values in selected fields.
- Compared reported square and cubic measurement data with a calculated value based on dimensional data stored in other fields.

Though not shown in this particular example, other object-oriented code blocks are provided as part of the DQE tool. The additional routines include the capability to:

- Compare data values with those in a given "look-up" table.
- Check to ensure a data value is within a stated range.
- Apply business "if...then" business rules, sometimes using other data values in a given record, to locate and report data errors.

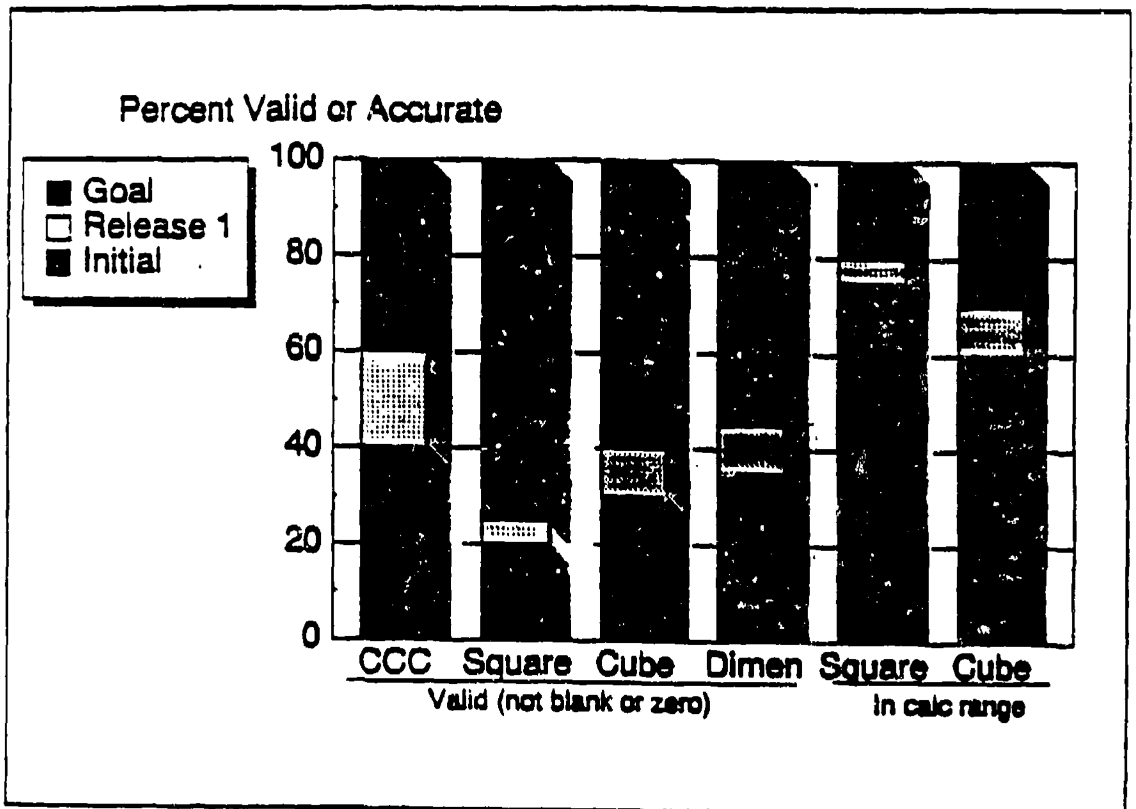


Figure A-2 Corrections Made to IDF During 3rd Quarter 1992

In addition to isolating specific errors, the DQE tool allowed the DAd to track progress toward restoring data quality. In this example, the effort to correct cargo codes was clearly a success. The data quality engineering tool contained the capability to produce many such "metrics of success".

Sample 2 - Functional Process Improvements

The knowledge of data and data errors that results form data quality engineering efforts can be applied to improving a functional process. In fact, as the following example illustrates, approximately 95% of data errors are the result of a faulty functional process and not the product of a computer malfunction or a error on the part of a data-entry clerk.

Data quality engineering revealed that technical data (dimensions, weights, fuel consumption factors, etc.) on Marine Corps equipment were incomplete and inaccurate. This kind of specific knowledge permitted Marine Corps analysts to focus and direct their efforts. In this example, Marine Corps analysts were able to determine that a specific set of data problems existed on vehicle-mounted shop sets. Currently, such equipment is carried in standard S-250 shelters, mounted on the bed of vehicles like the high-mobility, multi-purpose, wheeled vehicle (HMMWV). Current data files, however, have not kept pace with equipment modernization efforts. Data in current Marine Corps automated files include technical data describing the shop set mounted on an obsolete M1028 chassis. Technical data is current on the S-250 shelter, the HMMWV, and several configurations of shop sets.

Further, the data files reflected that various vehicle/shop set configurations are possible. However, useful technical data on current vehicle/shelter/shop set configurations were not available.

This analysis yielded a clear understanding of how the process of fielding new equipment has failed to generate the data required to satisfy current operational requirements. The fault was traced to a lack of documentation in the current Marine Corps systems used to enter and track this data and corrective action are underway.

Sample 3 - Cost Benefit of Data Quality

The impact of a data error varies with the magnitude of the error and the way in which the data may be used. Figure A-3 shows how a simple data error can result in $13.5M in additional operating costs! This is an example of an actual error that had been discovered in the Marine Corps Item Description File (IDF). Among other uses, the IDF provides a source for average fuel consumption rates. Rate data, in turn, is used in war-planning systems to automatically calculate and aggregate the fuel requirements of a combat force. Fuel requirements are converted to strategic lift requirements and become a factor in developing war plans, time-phasing the arrival of operational forces in a theater, and determining new ship-building priorities. In this particular instance, the average fuel consumption rate for a light armored

vehicle (LAV) was reported as 70 gallons per hour. In fact, the actual rate was 7 gallons per hour. Because fuel consumption data are automatically calculated and aggregated by planning systems, this kind of error easily goes undetected. Applied data quality engineering routines, on the other hand, just as easily identify such errors. In this instance, a DQE routine designed to flag fuel consumption data values not falling within two standard deviations of the norm captured this data error. The potential additional costs resulting from this error totaled $13.5M!

Item	Unit Cost	Incorrect Reqmt	Cost of Error	Correct Reqmt	Correct Cost
Fuel (gal)	$ .074	1.32M	$ 976,800	132K	$ 97,680
Refuelers	$ 47K	264	$ 12,400K	26	$ 1,240K
Ships (per day for 15 days)	$ 50K	2.2	$ 1,650K	0.2	$ 165K
Totals			$ 15,030K		$ 1,503K

Error cost estimates based on:

- **LAV fuel consumption of 70 vice correct value of 7 GPH**
- **MEB deployment with 60 days of supply**
- **Combat use rates and std conversion factors (i.e., 55 gal/barrel)**
- **Refueler and fuel (barrel) deck space requirements of 235 and 6.7 square feet respectively**
- **Average of 100K square feet of storage per ship**

Figure A-3 Additional Costs Resulting From Inaccurate Data

APPENDIX B

DATA QUALITY BASELINE ASSESSMENT REPORT

DATA QUALITY BASELINE ASSESSMENT REPORT

Executive Summary

I. Introduction

A. Background
B. Objectives of Project
C. Project Description
D. Identify DQE team and data experts who participated in the project

II. DQE Methodology (Describe the methodology used)

III. Data Quality Baseline

A. Historical Data Problems and Types of Assessments
B. Describe Data That Was Assessed
(data structure, file structure, rule-sets, etc.)
C. Measurement Method
(DQE automated tool, manual methods, validation process)
C. Results/Output/Data Trouble Reports
D. Data Quality Baseline
- Metric Calculation results
- Graphic Representations/Charts
- Previous baselines

IV. Root Cause Analysis

A. Describe the Suspect Data Analyzed
B. Describe Analysis Techniques and Results
C. For each root cause identified provide:
- Description
- Poor-Quality Cost Baseline (graphic representation/chart)
- Recommended Improvement Alternatives

DATA QUALITY BASELINE ASSESSMENT REPORT
(continued)

V. Improvement Results

A. Describe Formal Notification Process
B. Describe Improvements
- Corrective actions taken to fix errors
- Implemented improvement alternatives
- Disposition of recommendations not implemented

C. Provide Data Quality Benefits
- Improved data quality
- Reduced cost

VI. Summary of Recommendations

APPENDICES

May include:
- Raw Data, Data Structures, Data models, Activity Models
- Actual Rule-Sets
- Actual Reports
- Activity Based Cost Data
- References
- Definitions

APPENDIX C

ROLES AND RESPONSIBILITIES

Overall Responsibilities

For overall data administration responsibilities refer to DoD 8320.1-M (reference (d)). For the purpose of the DoD Data Quality Assurance Procedures, these Roles and Responsibilities have been further defined with respect to data quality assurance responsibilities. The following table, Table C-1, refers each role and the corresponding Chapters of this Manual that specifically address the responsibilities of those most involved with the data quality assurance process. However, it is recommended that all DoD personnel familiarize themselves with the entire contents of this Manual to gain a thorough understanding of the DoD Data Quality Assurance Procedures.

	ROLE	REFER TO SPECIFIED CHAPTER IN MANUAL
A.	The Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD (C3I))	Chapter 3
B.	OSD Principal Staff Assistant/ Chairman, Joint Chiefs of Staff (CJCS)	Chapter 3
C.	Heads of DoD Components	Chapter 3
D.	DoD Data Administrator (DAd)	Chapters 3, 4, 5
E.	Functional Data Administration (FDAd)/ Component Data Administrator (CDAd)	Chapters 3, 4, 5
F.	DASD (IM)	Chapter 3
G.	Director for Defense Information (DDI)/ DDI Functional Information Manager (FIM)	Chapter 3

Table C-1 Roles and Responsibilities

ROLE		REFER TO SPECIFIED CHAPTER IN MANUAL
H.	Database Administrators (DBAd)	Chapters 4, 5
I.	Data Administrators (DAd)	Chapters 3, 4, 5
J.	Technical Developers	Chapters 4, 5
K.	Automated Information Systems Program Managers (AIS PM)	Chapters 4, 5
L.	Data Stewards	Chapters 3, 4, 5
M.	Functional Managers	Chapters 3, 4, 5
N.	Functional Activity Program Manager (FAPM)	Chapters 3, 4, 5
O.	Program Managers (PM)	Chapters 3, 4, 5
P.	Customers/Users of Data	Chapters 3, 4

Table C-1 Roles and Responsibilities (continued)

Specific Responsibilities

1. Data Administrators - DAds throughout DoD must manage the quality of data throughout the data life-cycle. To support these efforts, DoD DAdm has established a Total Data Quality Management (TDQM) process which shall be used to ensure DoD data quality. The DoD DAd is responsible for developing the long-term vision, mission, and goals for the DoD Data Administration Program. The DoD DAd also establishes the overall goals and objectives for data quality assurance. Each Functional Data Administrator (FDAd) and Component Data Administrator (CDAd) prepares a strategic plan for their respective Functional Area or Component in accordance with the annual planning guidance provided by the DoD DAd. Throughout DoD, DAds and DBAds must incorporate their functional area or component data quality goals and objectives into their organization's annual plans. The DoD DAd will publish annual reports on the progress of DoD data quality assurance. The DoD DAd should also review performance results against the overall goals and objectives for data quality assurance. DoD DAdm must perform quality control activities to track and document continuous process improvements for DoD data quality assurance.

a. If required, the DoD DAd, FDAds, or CDAds will provide guidance and assistance in the development of these annual plans. By assessing the vision of the organization's future and coming to a consensus on a data quality goal, the FDAd, or CDAd will solidify their understanding of the ultimate data quality goals. They must communicate that goal throughout the organization.

b. The DAd is to make sure that the functional manager is aware of the DoD IM initiatives and data quality concerns. Building management awareness of the need for change and the benefits of data quality improvements by the TDQM process, will help establish a foundation for continuous data improvement efforts. Awareness can be increased by providing information on the TDQM process, advocating the manager's attendance at DoD DAdm conferences on data quality assurance, and inviting his/her participation in TDQM activities.

c. In order to obtain top-management support, the DAd and other functional experts may conduct a small, prototype effort. This effort should be used to make a case for the ramifications of having poor quality data and the costs associated with poor data. These assessments should be presented to top-management with a supporting Data Quality Plan.

d. A leader needs to be established for the data quality function. This individual will provide the lead for establishing baselines, performing assessments, prioritizing, providing solutions, and making final improvement recommendations. This role may be performed by the DBAd, DAd, AIS project manager, or technical developers. This individual has the overall operational responsibility for the quality of the data. This individual leader should be aware of the TQM discipline and DAdm. This leader will help top-management establish the cultural environment for implementing TDQM. The leader establishes a formal or informal DQE team consisting of the DAd, DBAd and other technical and functional experts and has the overall responsibility for implementing the DoD DQE methodology. Information on TDQM efforts should be forwarded by the DQE team leader to the DoD DAd so that it can be included in annual reports and included in future strategic plans.

e. The DoD DAd will provide the guidance and consultation to support Steps 1 and 2 in a DoD TDQM effort. DoD DAdm establishes the overall DoD data quality assurance environment and will assist organizations in identifying improvement projects, and developing implementation plans and prototype efforts.

f. As part of the review process, action plans should be reviewed by the DoD DAd, FDAds, or CDAds for the achievement of data quality assurance objectives. These action plans should have met the data quality goal, and should have described the organization's resources, tasks and milestones needed to implement the data quality objectives identified in the DASP (reference (c)). Resource requirements should be analyzed, in reference to each action plan, to determine areas of improvement. Training resources must be made available to support the organization's continued TDQM improvement efforts. Training plans should be updated to provide an immediate opportunity to use new skills developed throughout the TDQM project.

2. Functional and Technical Personnel - The data quality assurance leader identified in Step 1 of the TDQM process has the overall responsibility for implementing the DoD DQE methodology. This leader establishes a formal or informal DQE team consisting of the DAd, DBAd and other technical and functional experts. Throughout the DoD DQE effort, the leader meets periodically with team members to exchange ideas, review interim findings, seek answers to specific questions, and resolve issues.

a. The DQE team meets regularly throughout the DQE process and are considered a dedicated resource until the process is complete. The Source Data Experts, although not on the DQE team, are called upon throughout the DQE process for consultation and validation during the DEFINE, MEASURE and ANALYZE activities, and to implement corrective actions and improvement opportunities during the IMPROVE activity.

b. The DQE team will determine the specific data quality problems for the assessment and gather the appropriate data experts and supporting information. The DQE team must agree on a clear objective for the data quality engineering effort. Once the objective has been determined, the DQE team should identify the experts (i.e. end users, data entry clerks, DBAds, programmers) that have knowledge of the how the data values are created, updated, and maintained. These data experts should also understand the objective and be available for consultation throughout the DQE effort.

c. During the DQE MEASURE activity, the DQE team establishes the data quality baseline assessment. Functional and user feedback is vital at this stage, to ensure the assessment data is valid and depicts an accurate picture of the real data quality problems.

d. As DoD legacy systems migrate to target systems, technical developers must build data quality engineering into the design of the new system, thereby phasing out the need for separate DQE tools. For non-automated data quality engineering efforts, the DQE team should establish standard operating procedures with users for detecting, documenting, and reporting errors. The team should establish the measurement technique (i.e. sampling) and design a Data Trouble Report (DTR) along with instructions for use. The automated DQE tool should be configured to produce graphic and tabular data error reports.

e. As part of the DQE ANALYZE activity, the first step in implementing an effective corrective action is to identify the data source, and the data steward. The DoD DQE team examines suspect data where more than one source for similar data exists and if necessary, determines the best source for the data based on the quality assessments provided by the DoD DQE tool. Data stewards or experts are determined to identify the correct people required to support the DQE team in resolving data problems. Individual efforts can substantially contribute to the data quality assurance effort, even if undertaken outside the context of the DQE team. It is important to contact and involve the functional data stewards and functional, technical, and data experts who work with the data or are in the process every day. The DQE team must depend on them to identify causes of problems with their data and solutions or opportunities for improvements. People will contribute most when they are responsible for something. Therefore, if these individuals recognize that quality is their responsibility every day, it will become easy to accept the importance of being involved and providing resources necessary to improve data quality.

f. For the DQE IMPROVE activity, the DQE team must formally provide recommended improvement alternatives to one or all of the following (when applicable): data stewards, Functional Activity Program Managers (FAPM), Automated Information Systems Program Managers (AIS PM), and users depending on the type of problem (i.e. system, process, procedure or data design). Regardless of the type of problem, the data value error should be formally documented and provided to the source file data steward or DBAd for immediate corrective action. The data steward or DBAd should notify the DQE team when the error is corrected. If a solution alternative or corrective action cannot be implemented, then an explanation and solution alternatives should be provided to the DQE team. The DQE team should document all implemented solutions, corrective actions taken, and explanations in the DQE Data Quality Baseline Assessment Report.

g. The DQE team must monitor implementation progress of all improvement opportunities and corrective actions to data values. An improvement opportunity may take longer to implement than the time allotted for the DQE project due to the time needed to get plans approved and to allocate resources. In this case, the DQE team may assign individuals to follow up on the improvements periodically. The DQE team must reassess the data to determine how well the actual performance matches the planned improvements. Tracking the effectiveness of improvement efforts is actually considered a part of the measurement and analysis efforts. After the improvement and/or corrective actions are validated, the DQE team should document any improved data quality, reduced costs and the DQE performance data thoroughly in the Data Quality Baseline Assessment Report.

APPENDIX E: DATA VV&C TASK FORCE BRIEFING CHARTS

(1)

Eighth Modeling and Simulation I/DB Task Group Meeting

M&S Data VV&C Task Force Meeting

Iris Kameny — July 15, 1994

RAND

Eighth Modeling and Simulation I/DB Task Group Meeting

MEETINGS:

November 16—18, 1993: MORS SIMDAT Data VV&C Working Group

February 14, 1994: Data VV&C Task Force (first meeting) at IDA

March 22, 1994: VV&C Guidelines Subgroup Meeting at IDA

April 19, 1994: Data VV&C Task Force at IDA

May 20, 1994: Authoritative Data Sources Meeting at XOMT

DOCUMENTS:

"Data Verification, Validation and Certification to Improve the Quality of Data Used in Modeling," Jeff Rothenberg and Iris Kameny, in Proceedings of the 1994 Society for Computer Simulation (SCS) Summer Computer Simulation Conference (SCSC '94), LA Jolla, CA, July 18-20, 1994.

"Authoritative Data Sources for DoD Modeling and Simulation Application (Draft)," Bill Dunn and Mike Hopkins, 19 April 1994.

"Data Quality Assurance Procedures (draft)," OASD/C3I, February 1994.

"Data Quality Engineering Study Final Report," Hughes Information Technology Company for DISA/JIEO/CIM/DAPMO, December 1993.

Data VV&C Task Force
Long Range Objectives

Develop guidelines for performing Data VV&C coordinated with VV&A:

- Definitions and process
- Cost models and cost information
- Quality profile and metadata definitions

Address authoritative data sources and their responsibilities

Address role of M&S data centers between data sources and simulation centers

Definitions of Data VV&C

VV&C Definitions (April 19, 1994) from Data VV&C Task Force Meeting at IDA

Producer Data:

- Producer Data Verification: the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling.
- Producer Data Validation: the documented assessment of data by subject area experts and its comparison to known or best-estimate values within stated criteria and assumptions.
- Producer Data Certification: determination by the data producer that data have been verified and validated.

Definitions of Data VV&C (cont'd.)

VV&C Definitions (April 19, 1994) from Data VV&C Task Force Meeting at IDA

User Data

- User Data Verification: the use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and that data are transformed and formatted properly.
- User Data Validation: the documented assessment of data by subject area experts and its comparison to known or best-estimate values as appropriate for use in an intended M&S.
- User Data Certification: determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage

Database Quality Profile

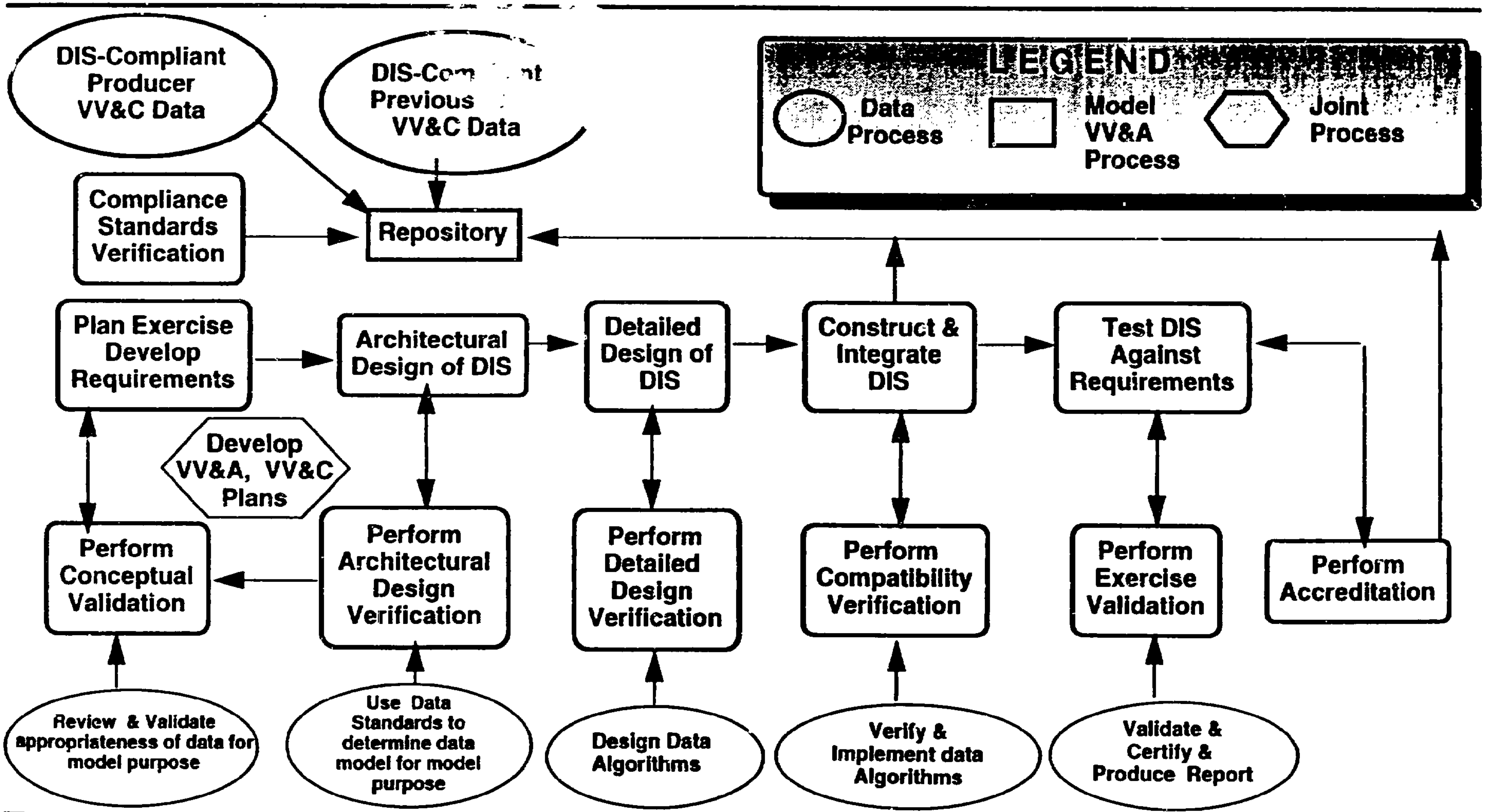
Comes from VV&C audit trail metadata from all levels

- DB level: certifies V&V applied to the DB as a whole
- Data-element level: certifies V&V applied to data elements and their domains
- Data value level: certifies V&V applied to individual data values

V&V audit trail information is open-ended

- Specifies who has done what when to verify/validate/certify the data
- Applies to data values, metadata values, data-element definitions, and the DB as a whole
- Represents both producer and user V&V

Data VV&C as Part of the DIS Process



RAND

7 7/5/94 9:39 PM
Data Stds 14 Jul 94

Authoritative Data Sources: Problem

No Service organization is in place to serve as comprehensive authoritative data source for that Service

- Authorized sources: result of instructions or directives that authorize funding for organizations and describe in detail what the organization is to do, what areas it has cognizance over, and what authority it has (e.g., DMA, DIA)
- De facto sources: become authorities because of the information they possess (e.g., Air Force Logistics Command at Wright Patterson, Ships Parts Control Center at Mechanicsburg PA, Army TRADOC Analysis Center (TRAC) at Ft. Leavenworth
- Factors contributing to multiple authorities: resolution and aggregation, classification

Authoritative Data Sources: Draft Paper

Draft paper "Authoritative Data Sources for DoD Modeling and Simulation Applications (April 19, 1994)

- Addresses
  - Service agency names and authoritative sources according to mission functionality
  - Data Centers with customers and functionalities they serve
  - Potential opportunities for sharing and reuse
  - Responsibilities of data centers and data customers

Authoritative Data Sources: Draft Paper (cont'd.)

- Currently
  - Three levels of Army weapon system data: high resolution (CCTT), medium, resolution (TRAC), low resolution (CAA)
  - Navy: listing of data sources that could be useful
  - Air Force: external data sources
  - Unified Commands, Specified Commands and Joint Applications
    - CENTCOM Conventional Force Database
    - CENTCOM Master Simulation Database
    - DMA databases

Authoritative Data Sources Responsibilities

- Use of data modeling and data standards
- Carrying out of data VV&C
- Configuration management of data and processes producing data
- Help to M&S users of data
- Handling of data security issues such as data aggregation
- Participation in M&S VV&A

Data VV&C Guidelines Subgroup Status

VV&C Guidelines from April 19th Meeting

- Need to define VV&C process related to VV&A process for DIS (attend DIS VV&A Working Group meetings) and work up for non-DIS
  - Dale Pace re: Navy VV&A process
  - Ray Miller re: Air Force VV&A process
  - Army has a VV&A model we can use
- Need to define process for getting products such as VV&C Guidelines accepted as part of DoD M&S policy and procedures
- Continue work on quality profile: RAND

Authoritative Data Sources Subgroup Status (May 20th Meeting)

- Review and agree on TRAC taxonomy
- Agree to maintain Authoritative Data Sources as Directory
- Need to get participation from J8 and NASA: Bill Dunn
- Data aggregation security and release authority issues: Allen Hess and John Coale
- Point paper on data aggregation issues: Mike Hopkins
- Coordination of overall responsibilities for data centers: LCDR George Flax

7/15/94 Authoritative DS

BMDO TEST DATA CENTERS
LESSONS LEARNED

15 JULY 1994
DMSO VV&C TASK FORCE
AUTHORITATIVE DATA SOURCES SUBGROUP
Presented By:

H. ALLEN HESS
for
OSD/JTAMS

PRA
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TOPICS

- RELEASE AUTHORITY
- DATA AGGREGATION AND CLASSIFICATION
- SECURITY

PRA/HAHLR.R.94/DMSO802.BRF-2

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RELEASE AUTHORITY - ISSUES

- WHAT IS RELEASE AUTHORITY?
- BMDO TEST DATA CENTERS (D/C) MUST HAVE REASONABLE AUTHORITY OVER THE DATA THEY MANAGE
- THE ORIGINATING AUTHORITY FOR RELEASE OF A SPECIFIC DATA SET MAY NOT WISH TO RELEASE CONTROL OVER THE DATA
- A USER WHO HAS NEED TO KNOW AND MEETS ALL OTHER REQUIREMENTS FOR EXAMINING THE DATA MUST BE ABLE TO GAIN ACCESS TO THE DATA

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RELEASE AUTHORITY - DEFINITION

- GUIDANCE - DoD DIRECTIVE No. 5230.11, "DISCLOSURE OF CLASSIFIED MILITARY INFORMATION TO FOREIGN GOVERNMENT AND INTERNATIONAL ORGANIZATIONS", 16 June 1992

  - DEFINES "RELEASE AUTHORIZATION" AS: "BEFORE APPROVAL OF INITIATIVES THAT COULD LEAD TO A SALE, LEASE, LOAN, OR GRANT OF MILITARY EQUIPMENT, OBTAIN AUTHORIZATION FROM THE APPROPRIATE DESIGNATED DISCLOSURE AUTHORITY FOR DISCLOSURE OF ALL NECESSARY CLASSIFIED EQUIPMENT AND INFORMATION REQUIRED FOR SYSTEM OPERATION, EMPLOYMENT, MAINTENANCE, AND TRAINING, INCLUDING SYSTEM SOFTWARE"

  - WHILE THIS IS NOT OUR NOTION OF RELEASE AUTHORITY IT DOES SUGGEST RELEASE AUTHORITY ENTAILS: 1) THE TRANSFER OF SOMETHING TANGIBLE, 2) APPROVAL FROM AN APPROPRIATE DISCLOSURE AUTHORITY, AND 3) SUPPLY REQUISITE INFORMATION TO ASSIST WITH THE PROPER USE OF THE TANGIBLE BEING TRANSFERRED

Photon Research Associates, Inc.

RELEASE AUTHORITY - DEFINITION CONTINUED

- THE SUBJECT OF RELEASE AUTHORITY INCLUDES: SECURITY CLASSIFICATION GUIDANCE, CLASSIFICATION OF DATA, USER CLEARANCES, DISCLOSURE, NEED TO KNOW, SECURITY POLICY, PROGRAM DATA POLICY, AND DATA ACCESS

- MY SUGGESTED WORKING DEFINITION IS: DATA RELEASE AUTHORITY REPRESENTS THE ABILITY TO DISCLOSE DATA/INFORMATION AS ALLOWED BY THE ORIGINATING AUTHORITY IF CERTAIN CONDITIONS ARE SATISFIED. (THESE CONDITIONS INCLUDE THE RELEASE AUTHORITY ATTRIBUTES LISTED ABOVE)

- SOME OTHER THOUGHTS: BEFORE DATA CAN BE RELEASED THERE MUST BE RULES FOR DISCLOSURE. DISCLOSURE IS NOTHING MORE THAN MAKING DATA/INFORMATION AVAILABLE. DISSEMINATION/DISTRIBUTION IS THE ACTION BY WHICH DISCLOSURE TAKES PLACE. DISSEMINATION CAN BE LIMITED OR RESTRICTED, OR IT CAN BE UNRESTRICTED (PUBLIC DISCLOSURE)

PRA Photon Research Associates, Inc.

RELEASE AUTHORITY - DEFINITION CONTINUED

- DISTRIBUTION IS LIMITED THROUGH THE USE OF DISTRIBUTION STATEMENTS DEFINED IN DOD DIRECTIVE NO. 5230.24, "DISTRIBUTION STATEMENTS ON TECHNICAL DOCUMENTS", 18 MAR 87. PUBLIC DISCLOSURE IS CLARIFIED IN DOD DIRECTIVE NO. 5230.25, "WITHHOLDING OF UNCLASSIFIED TECHNICAL DATA FROM PUBLIC DISCLOSURE", 6 NOV 84.

PRA Photon Research Associates, Inc.

BMDO TEST/EXPERIMENT DATA RELEASE AUTHORITY CONCERNS

- FEB 91 VERSION OF DIRECTIVE No. 3240 REQUIRES THAT ALL TEST AND EXPERIMENT DATA MUST BE ARCHIVED AT THE APPROPRIATE BMDO TEST DATA CENTER BUT DOES NOT ADDRESS RELEASE AUTHORITY
- PRESENTLY DATA CAN BE TRANSFERRED TO THE D/C MANAGER WITHOUT TRANSFERRING RELEASE AUTHORITY WHICH ESSENTIALLY PREVENTS D/C PERSONNEL AND USERS FROM ACCESSING THE DATA
- WHEN ATTEMPTING TO OBTAIN RELEASE AUTHORITY THE EXPERIMENT/TEST MANAGER (ORIGINATING AUTHORITY) IS NO LONGER AVAILABLE OR REQUIRES A LENGTHY PROCESS

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LESSONS LEARNED

- DIRECTIVE No. 3240 SHOULD REQUIRE RELEASE AUTHORITY ACCOMPANY THE ARCHIVE DELIVERABLES
- EACH PROGRAM SHOULD COMPILE A LIST OF USERS WITH NEED TO KNOW
- PROGRAM CLASSIFICATION GUIDANCE MUST BE ON FILE AT THE D/C AND MUST CONTAIN DISTRIBUTION STATEMENT INFORMATION
- USE A TEST CASE TO ESTABLISH RELEASE AUTHORITY STANDARDS
- DEVELOP STANDARD FORMS FOR USER DATA REQUESTS AND RELEASE AUTHORITY

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LESSONS LEARNED CONTINUED

- IT IS FAR SIMPLER TO DEAL WITH RELEASE AUTHORITY IF THE DATA IS ORGANIZED BY PROGRAMS - THIS DOES NOT PREVENT PROVIDING THE NECESSARY DATA VIEWS

Stds User Info system Security

- D/C, DCSC, PSAG/UPIG, BMDO/PCI, BMDO/DSIS, BMDO AQT, and NSA BMDO/TR MUST ALL PARTICIPATE IN THE SOLUTIONS

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RELEASE AUTHORITY CONSIDERATION

- RELEASE AUTHORITY FOR AN EXPERIMENT/TEST DATA SET MUST ADDRESS CATALOG INFORMATION, METADATA, AND DATA; THE CLASSIFICATION, DISTRIBUTION, AND NEED TO KNOW MAY NOT BE THE SAME FOR EACH OF THESE

Photon Research Associates, Inc.

RELEASE AUTHORITY TEST CASE

- TRANSFER CATALOG AND METADATA INFORMATION FROM IBSS DATABASE AT NRL/BACKGROUNDS DATA CENTER (BDC) TO NASA/NATIONAL SPACE SCIENCE DATA CENTER (NSSDC)
- IDENTIFY AND DESCRIBE CATALOG, METADATA, AND DATA
- BDC MANAGER AND SCIENCE TEAM REVIEW INFORMATION INCLUDING CLASSIFICATION GUIDANCE AND DISTRIBUTION
- BDC SIGNOFF FOR RELEASE
- BDC LETTER TO EXPERIMENT PROGRAM MANAGER AND CHIEF SCIENTIST FOR SIGNOFF
- COORDINATE PACKAGE WITH BMDO SECURITY, INFORMATION SYSTEMS, TEST AND EVALUATION, AND EXTERNAL AFFAIRS
- SEND APPROVED PACKAGE TO DoD EXTERNAL AFFAIRS

PRA/HAH/JUL94/DMSO002.BRF/11

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AGGREGATE DATA CLASSIFICATION ISSUE LESSONS LEARNED

- EARLY ATTEMPTS TO SOLVE- MATRIX (PRODUCT OF CATALOG ENTRIES)
- ISSUE HAS BEEN AND PRESENTLY IS BEING ADDRESSED BY BMDO TEST DATA CENTERS STANDARDS COMMITTEE (DCSC) AND THE PHENOMENOLOGY SCIENCE AND ANALYSIS GROUP (PSAG)/USER PRODUCT INFORMATION GROUP (UPIG)
- INCLUDE BMDO SECURITY, INFORMATION SYSTEMS, AND OTHERS
- DETERMINE CLASSIFICATION LEVELS BY PROGRAM, RECORD TYPE, FIELD TYPE, ETC. FOR CATALOG, METADATA, AND INSTANCE DATA

PRA
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AGGREGATE DATA CLASSIFICATION ISSUE LESSONS LEARNED CONTINUED

- MAKE DETERMINATION BASED ON OWNERSHIP OF DATA, CLASSIFICATION, DISTRIBUTION STATEMENT, AND EVALUATION BY TECHNICAL REPS, ASSISTANCE FROM BMDO SECURITY AND INFORMATION SYSTEMS
- HAVE SUBJECT EXPERTS AT THE D/C ON EACH PROGRAM
- EVALUATE FINAL DECISION BY COMPARING AGAINST THE "THREAT"- BE CAUTIOUS.

7/15/94 3

AMSAA AS AN AUTHORITATIVE DATA SOURCE

15 JULY 1994

Mark Ralston

DMSO I/DB TECHNICAL WORKING GROUP - DATA VV&C TASK FORCE
AUTHORITATIVE DATA SOURCES SUBGROUP

AUTHORITATIVE DATA SOURCE

DEFINITION

- Two alternative definitions:

1 • An authoritative data source is an organization designated and recognized as the producer of best-estimate values for one or more categories of data.

2 • An authoritative data source is an organization designated to conduct producer VV&C activities for one or more categories of data.

1. based on historical expertise
2. define more as what it does

AUTHORITATIVE DATA SOURCES

RESPONSIBILITIES

Major responsibilities include:

Maintain subject matter expertise in those technical areas that relate to the data categories the organization is responsible for.

? Produce data to meet the needs of data users; either to fill repositories or to meet the need for "on demand" data.

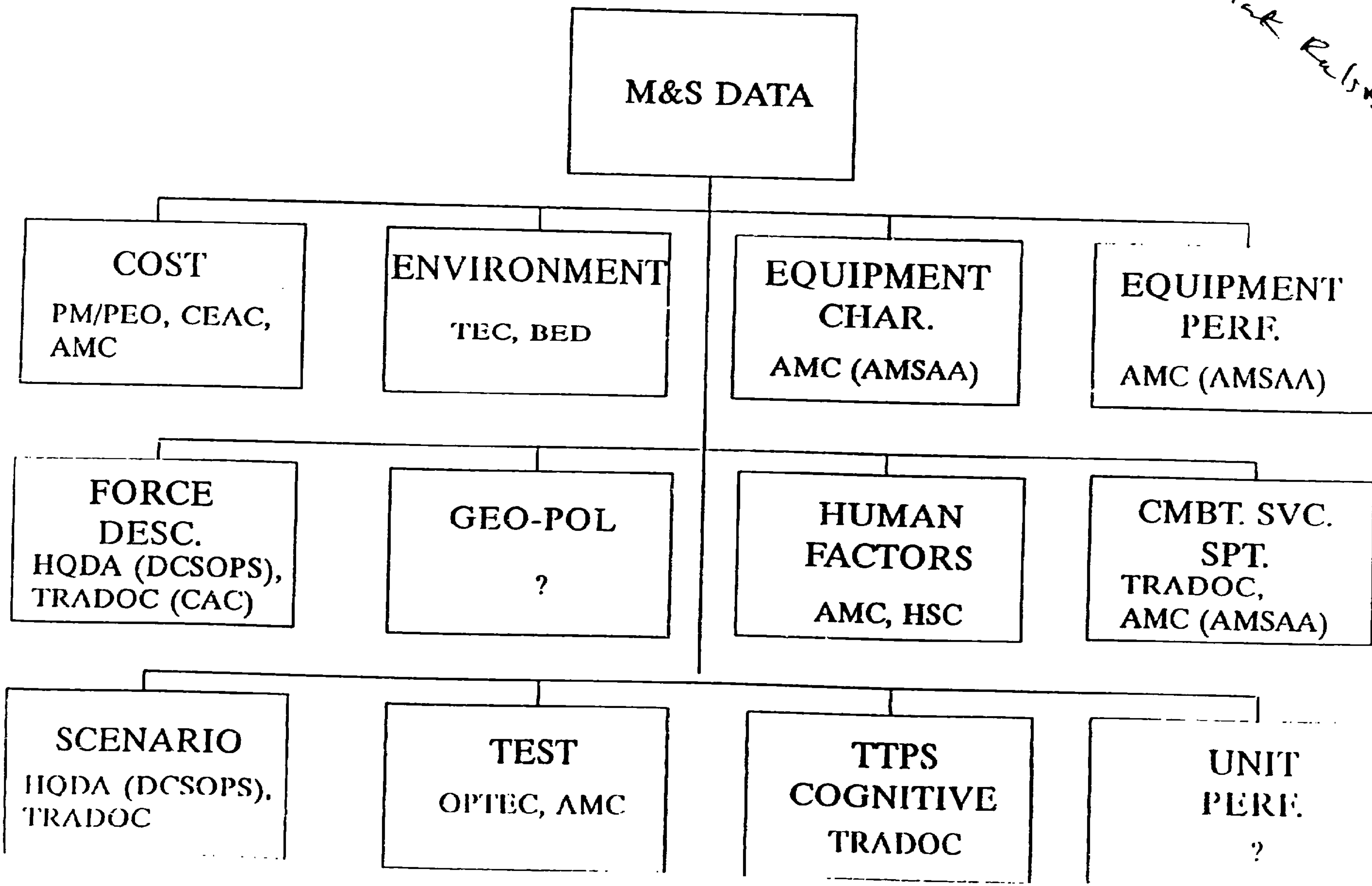
Conduct data producer verification and validation.

Prepare data producer certification.

Develop and maintain appropriate data base technology to meet the needs of data centers and data users; meet requirements for data standards and timeliness.

ARMY AUTHORITATIVE DATA SOURCES

CATEGORIES OF DATA



AMSAA AS AN AUTHORITATIVE DATA SOURCE

ORGANIZATION AND MISSION

COMBAT EVALUATION

ARMOR
AVIATION
AIR DEFENSE
INFANTRY
FIELD ARTILLERY

COMBAT INTEGRATION

C4I
SIMULATION
SUPPORT SYSTEMS

RELIABILITY ANALYSIS

COMBAT SYSTEMS
SUPPORT SYSTEMS
RELIABILITY AND
ENGINEERING

LOGISTICS ANALYSIS

INTEGRATED LOGISTICS
LOGISTICS STUDIES
READINESS AND
SUSTAINABILITY

Authoritative Source Data Mission delegated to AMSAA by AMC. AMSAA serves as the focal point for equipment performance and characteristic data requests.

Mission:
- Serve as the independent technical evaluator for major systems. (Produce TDPs, IEPs, IERs)
- Perform Materiel System Analyses
- Perform Logistics and RAM Analyses.
- Serve as VV&C authority for equipment performance data. (Authoritative source.)
- JTCG/ME, Model Development/VVA

AMSAA AS AN AUTHORITATIVE DATA SOURCE

EXAMPLE DATA CONTENTS

FIELD ARTILLERY
Data Example: Lethal Area (m2) for a given weapon/target combination.
Process: Calculate using inputs from models and simulations, weapon characteristics; validated from test data.

ARMOR
Data Example: Probability of Kill Given a Shot (Pk/S) for a weapon/target combination as a function of range.
Process: Determine delivery accuracy for round (test data analysis), obtain vulnerability estimates from ARL (Pk/H data generated by ARL models and validated by test data), combine accuracy and vulnerability estimates..

TARGET ACQUISITION
Data Example: Lock-on boundary ranges for IR weapon/target combinations.
Process: Determine IR missile characteristics, determine target signature charateristics, calculate lock-boundaries.

COMMUNICATION
Data Example: Probability of communications for a given scenario.
Process: Determine system/scenario characteristics, run simulation.

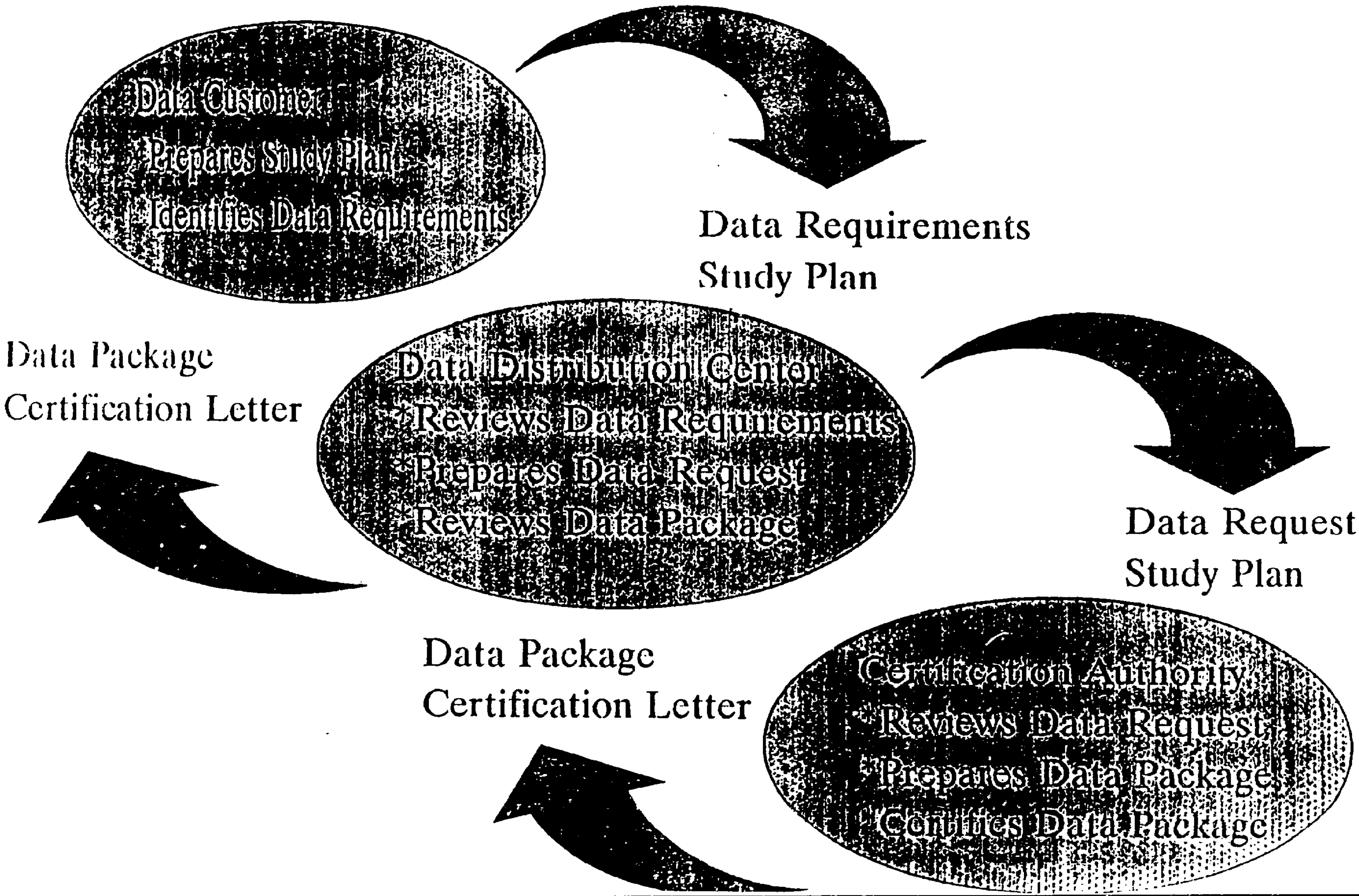
AMSAA AS AN AUTHORITATIVE DATA SOURCE

"ON DEMAND" DATA

- TRAC serves as a Data Distribution Center (Repository) for data users within TRADOC.
- AMSAA produces new data to support data users only when necessary.
- Much of the data produced by AMSAA is model output or the result of calculations. Input variables are often unique for a specific user's need (specific study).
- This requires the ability to generate data of a recognized "standard" type with different input variables "on demand" to support a single data request.

AMSAA AS AN AUTHORITATIVE DATA SOURCE

DATA VV&C PROCESS



DATA VV&C EXAMPLE - FARV COEA

- TRAC-OAC Receives Task to Perform COEA
  - Prepares Study Plan
  - Identifies Data Requirements
  - Submits Data Requirements to TRAC-SAC-D3

- TRAC-SAC-D3 Prepares Data Request
  - Identifies appropriate source and certification authority
  - Prepares written data request (letter and target matrix)
  - Submits data request to AMSAA

- AMSAA Prepares Data Package and Certification
  - Reviews data request
  - Clarifies any issues pertaining to intended use
  - Obtains input from other AMC sources
  - Generates required data (lethal areas)
  - Conducts formal data review
  - Prepares and signs certification letter
  - Submits data package electronically in TADS format

APPENDIX F: ACRONYMS

A&T	Acquisition and Technology
AAW	Anti-Air Warfare
ACI	A&T CIM Integration
ADS	Authoritative Data Sources
ADT	Abstract Data Type
AF	Air Force
AFC4A	an Air Force organization
AI	Artificial Intelligence
AIS	Automated Information System
AITS	a joint program office that supports DMSO
ALSP	Aggregate Level Simulation Protocol
AMC	Army Material Command
AMIP	Army Model Improvement Program
AMSAA	Army Material Systems Analysis Activity
AMSMO	Army Model and Simulation Management Office
ANL	Aberdeen National Laboratory
ANSI	American National Standards Institute
ARL	ARL-UT Research (name of a company)
ARMS	Automated Repository for Models and Simulations
ARPA	Advanced Research Project Agency
ASD	Assistant Secretary of Defense
ASW	Anti-Submarine Warfare
ATD	Advanced Technology Demonstration
ATO	Afloat Training Organization
BFTT	Battle Force Tactical Trainer Project
BINHEX	Macintosh format for sending formatted text
BLOBS	Binary Large Objects
BMDO	Ballistic Missile Defense Organization
C3I	Command, Control, Communications and Intelligence
CCTT	Close Combat Tactical Trainer Project
CDAd	Component Data Administrator
CDIF	CASE Data Interchange Format
CENTCOM	Central Command

CEOS	Committee on Earth Observation Satellites
CFDB	Conventional Force Data Base
CGF	Computer Generated Forces
CI	Catalog Interoperability
CIM	Corporate Information Management and Center for Information Management
CINC	Commander-In-Chief
CISS	Center for Information System Security
CNA	Center for Naval Analysis
CNO	Center for Naval Operations
COE	Common Operating Environment
COEA	Cost and Effectiveness Analysis
CONOPS	Concept of Operations
COTS	Commercial Off The Shelf
DA	Data Administration
DAAC	Distributed Active Archive Centers
DAB	Defense Acquisition Board
DAPMO	Data Administration Program Management Office
DASD	Deputy Assistant Secretary of Defense
DASP	Data Administration Strategic Plan
DAd	Data Administrator
DB	Data Base
DBAd	Data Base Administrator
DBMS	Data Base Management System
DBTWG	Information/Data Base Technology Working Group
DDR&E	Director Development Research and Engineering
DDRS	Defense Data Repository System
DIA	Defense Intelligence Agency
DIF	Data Interchange Format
DIS	Distributed Interactive Simulation
DISA	Defense Information Systems Agency
DISO	Defense Information Services Organization
DISWG	Distributed Information System Working Group
DMA	Defense Mapping Agency
DMSO	Defense Modeling and Simulation Office
DON	Department of Navy
DRB	Defense Resources Board

DSB	Defense Science Board
DSCS	Data Centers Standards Committee
DSI	Defense Simulation Internet
DTIC	Defense Technical Information Center
DoD	Department of Defense
DoDD	Department of Defense Directive
E&E2	Environment and Environmental Effects
E2DIS	Environmental Effects in Distributed Interactive Simulation Project
EA	Executive Assistant
ECMA	European Computers Manufacturers Association
ECS	EOSDIS Core System
EDHS	ECS Data Handling System
EDI	Electronic Data Interchange
EOS	Earth Observation Satellite
EOSDIS	Earth Observation Satellite Distributed Information System
EW	Electronic Warfare
EXCIMS	Executive Council for Modeling and Simulation
FAPM	Functional Activity Program Manager
FDAd	Functional Data Administrator
FFRDC	Federally Funded Research and Development Center
FIPS	Federal Information Processing Standard
FORN	Foreign
FWG	Functional Working Group
FY	Fiscal Year
GCCS	Global Command and Control System
GPS	Global Positioning System
HDF	Hierarchical Data Format
HQ	Headquarters
HW	Hardware
IAC	Information Analysis Center
IC	Intelligence Community
ICASE	Integrated Computer Aided Software Engineering
IDEF	Integrated Computer Aided Definition Language
IDEF0	IDEF process modeling methodology
IDEF1X	IDEF data modeling methodology
IDEF3	IDEF process modeling methodology
IDEF4	IDEF object oriented modeling methodology

IDEFxx	IDEF whatever
IDL	Interface Definition Language
IDN	International Directory Network
IEC	International Electrotechnical Commission
IM	Information Manager
INFORMIX	name of a commercial relational database management system
INFOSPAN	name of a commercial information resource dictionary system product
IPL	Integrated Project List
IPTs	Integrated Process Team
IRDS	Information Resource Dictionary System
IRR	Information Resource Repository
ISO	International Organization of Standardization
ITSEC	Interservice/industry training systems and education conference
JCS	Joint Chief of Staff
JDBE	Joint Data Base Elements Project
JESEBEL	Joint Electromagnetic Signature and Effects Database Library
JIEO	Joint Interoperability Engineering Organization
JMCIS	Joint Marine Corps Information System
JOPES	Joint Operation Planning and Execution System
JPL	Jet Propulsion Laboratory
JPO	Joint Project Office
JROC	Joint Requirements Oversight Council
JS	Joint Staff
JSIMS	Joint Simulation System Project
JTAMS	Joint Tactical Missile Signatures Program
JTC1	Joint Technical Committee 1
JUDI	Joint Universal Data Interpreter
KBSI	name of a company
LLNL	Lawrence Livermore National Laboratory
M&S	Modeling and Simulation
MAISRC	Major Automated Information System Review Council
MAJCOM	Major Command
MC&G	Mapping, Charting and Geodesy
MCEB	Military Communications and Electronics Board
MEL	Master Environmental Library Project
MLS	Multi-Level Security

MOA	Memorandum of Agreement
MORS	Military Operations Research Society
MS&A	Modeling, Simulation and Analysis
MSWG	Modeling and Simulation Working Group
NASA	National Aeronautics and Space Administration
NAVEUR	Navy Europe
NDI	Non Developmental Item
NIST	National Institute of Standards and Technology
NOAA	National Oceanographic and Atmospheric Agency
NRL	Naval Research Laboratory
NRaD	Navy Research and Development
NSI	NASA Science Internet
NSS	National Security Strategy
NWTDB	Navy Warfare Tactical Database
OASIS	Operational Analysis and Simulation Interface System
ODBC	Object Data Base Connectivity standard
ODDRE	Office of the Director Development, Research and Engineering
ODISC4	Office of the Director of Information Systems Command, Control, Communications and Computers
OMC	Object Management Committee
OMG	Object Management Group
ONR	Office of Naval Research
OO	Object Oriented
OODBMS	Object Oriented Data Base Management System
OPLAN	Operational Plan
ORG	Organization
OSD	Office of the Secretary of Defense
OUSD	Office of the Under Secretary of Defense
P&L	Production and Logistics
PCTE	Portable Common Tool Environment
PDU	Protocol Data Unit
PEO	Program Executive Office
PM	Program Manager
POC	Point of Contact
PPBS	Planning, Programming and Budgeting System
PSA	Principal Staff Assistant
PSAG	Phenomenology Science and Analysis Group

Ph	Probability Hit
Pk	Probability Kill
RCL	Rule Constraint Language
RDBMS	Relational Data Base Management System
RFC	Requests for Changes
RFP	Request for Proposal
S&T	Science and Technology
SAFOR	Semi Automated Forces
SAG	Senior Advisory Group
SAI	Subject Area Information
SASC	Senate Armed Services Committee
SBIS	Sustaining Base Information System
SC	Standing Committee
SDS	Software Distribution System
SGI	Stilicon Graphics Inc.
SGML	Standard Genealized Markup Language
SIG	Special Interest Group
SIM	Simulation
SIMDAT	Simulation Data
SIMDATAM	Simulation Data Management
SOCOM	Special Operations Command
SQL	Standard Query Language
SROC	Senior Readiness Oversight Council
STRICOM	Simulation Training and Instrumentation Command
T&E	Test and Evaluation
TAP	Technology Area Plan
TAFIM	Technical Architecture Framework for Information Management
TBD	To Be Decided
TC	Technical Committee
TF	Task Force
TGOO	Technical Group for Object Oriented
TMS	Tactical Missile Signature
TRAC	Training Command
TRADOC	Training and Doctrine Command
TTS	Tactical Training Strategy
TWG	Technical Working Group
UPIG	User Products Information Group

URL	Universal Resource Locator
USACOM	US Atlantic Command
USAFE	US Air Force Europe
USAREUR	US Army Europe
USD	Under Secretary of Defense
USMC	US Marine Corp
UTM	Universal Transverse Mercator
UTSS	Universal Threat System for Simulators Project
V&V	Verification and Validation
VV&A	Verification, Validation and Accreditation
VV&C	Verification, Validation and Certification
WAIS	Wide Area Information Server
WG	Working Group
WPC	Warrior Preparation Center
WWMCCS	World Wide Military Command and Control System
WWW	World Wide Web
X3H2	an ANSI standards group
X3H4	an ANSI standards group
X3L8	an ANSI standards group
XOM	Air Force modeling and simulation office
XPSD	Air Force organization